This report is one in a series of volumes published by the U.S. Environmental Protection Agency (EPA) to provide information of general interest regarding environmental issues associated with specific industrial sectors. The documents were developed under contract by Abt Associates (Cambridge, MA), and Booz-Allen & Hamilton, Inc. (McLean, VA). This publication may be **purchased** from the Superintendent of Documents, U.S. Government Printing Office. A listing of available Sector Notebooks and document numbers are included on the following page.

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Electronic versions of all Sector Notebooks are available free of charge at the following web address: **www.epa.gov/oeca/sector**. Direct technical questions to the “Feedback” button at the bottom of the web page.

Cover photograph courtesy of American Iron and Steel Institute.

EPA/310-R-95-005

EPA Office of Compliance Sector Notebook Project

Profile of the Iron and Steel Industry

September 1995

Office of Compliance
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency
401 M St., SW (MC 2221-A)
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EPA/310-R-95-003.	Wood Furniture and Fixtures Industry	Bob Marshall	564-7021
EPA/310-R-95-004.	Inorganic Chemical Industry*	Walter DeRieux	564-7067
EPA/310-R-95-005.	Iron and Steel Industry	Maria Malave	564-7027
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EPA/310-R-95-018.	Transportation Equipment Cleaning Ind.	Virginia Lathrop	564-7057
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EPA/310-R-97-002.	Ground Transportation Industry	Virginia Lathrop	564-7057
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EPA/310-R-97-006.	Plastic Resin and Man-made Fiber Ind.	Sally Sasnett	564-7074
EPA/310-R-97-007.	Fossil Fuel Electric Power Generation Ind.	Rafael Sanchez	564-7028
EPA/310-R-97-008.	Shipbuilding and Repair Industry	Anthony Raia	564-6045
EPA/310-R-97-009.	Textile Industry	Belinda Breidenbach	564-7022
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EPA/310-R-98-001.	Aerospace Industry	Anthony Raia	564-6045
EPA/310-R-98-002.	Agricultural Chemical, Pesticide, and Fertilizer Industry	Amy Porter	564-4149
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EPA/310-R-98-004.	Agricultural Livestock Production Ind.	Ginah Mortensen	(913)551-7864
EPA/310-R-98-005.	Oil and Gas Exploration and Production Industry	Dan Chadwick	564-7054
EPA/310-R-98-008.	Local Government Operations	John Dombrowski	564-7036

*Spanish Translations Available

Industry Sector Notebook Contents: Iron and Steel Industry

Exhibits Index

List of Acronyms

AFS -	AIRS Facility Subsystem (CAA database)
AIRS -	Aerometric Information Retrieval System (CAA database)
BIFs -	Boilers and Industrial Furnaces (RCRA)
BOD -	Biochemical Oxygen Demand
CAA -	Clean Air Act
CAAA -	Clean Air Act Amendments of 1990
CERCLA -	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS -	CERCLA Information System
CFCs -	Chlorofluorocarbons
CO -	Carbon Monoxide
COD -	Chemical Oxygen Demand
CSI -	Common Sense Initiative
CWA -	Clean Water Act
D&B -	Dun and Bradstreet Marketing Index
ELP -	Environmental Leadership Program
EPA -	United States Environmental Protection Agency
EPCRA -	Emergency Planning and Community Right-to-Know Act
FIFRA -	Federal Insecticide, Fungicide, and Rodenticide Act
FINDS -	Facility Indexing System
HAPs -	Hazardous Air Pollutants (CAA)
HSDB -	Hazardous Substances Data Bank
IDEA -	Integrated Data for Enforcement Analysis
LDR -	Land Disposal Restrictions (RCRA)
LEPCs -	Local Emergency Planning Committees
MACT -	Maximum Achievable Control Technology (CAA)
MCLGs -	Maximum Contaminant Level Goals
MCLs -	Maximum Contaminant Levels
MEK -	Methyl Ethyl Ketone
MSDSs -	Material Safety Data Sheets
NAAQS -	National Ambient Air Quality Standards (CAA)
NAFTA -	North American Free Trade Agreement
NCDB -	National Compliance Database (for TSCA, FIFRA, EPCRA)
NCP -	National Oil and Hazardous Substances Pollution Contingency Plan
NEIC -	National Enforcement Investigation Center
NESHAP -	National Emission Standards for Hazardous Air Pollutants
NO_2 -	Nitrogen Dioxide
NOV -	Notice of Violation
NO_X -	Nitrogen Oxide
NPDES -	National Pollution Discharge Elimination System (CWA)
NPL -	National Priorities List
NRC -	National Response Center

NSPS -	New Source Performance Standards (CAA)
OAR -	Office of Air and Radiation
OECA -	Office of Enforcement and Compliance Assurance
OPA -	Oil Pollution Act
OPPTS -	Office of Prevention, Pesticides, and Toxic Substances
OSHA -	Occupational Safety and Health Administration
OSW -	Office of Solid Waste
OSWER -	Office of Solid Waste and Emergency Response
OW -	Office of Water
P2 -	Pollution Prevention
PCS -	Permit Compliance System (CWA Database)
POTW -	Publicly Owned Treatments Works
RCRA -	Resource Conservation and Recovery Act
RCRIS -	RCRA Information System
SARA -	Superfund Amendments and Reauthorization Act
SDWA -	Safe Drinking Water Act
SEPs -	Supplementary Environmental Projects
SERCs -	State Emergency Response Commissions
SIC -	Standard Industrial Classification
SO_2 -	Sulfur Dioxide
SO_X -	Sulfur Oxides
TOC -	Total Organic Carbon
TRI -	Toxic Release Inventory
TRIS -	Toxic Release Inventory System
TCRIS -	Toxic Chemical Release Inventory System
TSCA -	Toxic Substances Control Act
TSS -	Total Suspended Solids
UIC -	Underground Injection Control (SDWA)
UST -	Underground Storage Tanks (RCRA)
VOCs -	Volatile Organic Compounds

I. INTRODUCTION TO THE SECTOR NOTEBOOK PROJECT

I.A. Summary of the Sector Notebook Project

Environmental policies based upon comprehensive analysis of air, water and land pollution are an inevitable and logical supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multi-statute solutions to facility permitting, enforcement and compliance assurance, education/ outreach, research, and regulatory development issues. The central concepts driving the new policy direction are that pollutant releases to each environmental medium (air, water and land) affect each other, and that environmental strategies must actively identify and address these inter-relationships by designing policies for the "whole" facility. One way to achieve a whole facility focus is to design environmental policies for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition of the need to develop the industrial “sector-based” approach within the EPA Office of Compliance led to the creation of this document.

The Sector Notebook Project was initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information for eighteen specific industrial sectors. As other EPA offices, states, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded. The ability to design comprehensive, common sense environmental protection measures for specific industries is dependent on knowledge of several inter-related topics. For the purposes of this project, the key elements chosen for inclusion are: general industry information (economic and geographic); a description of industrial processes; pollution outputs; pollution prevention opportunities; Federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community and the public.

For any given industry, each topic listed above could alone be the subject of a lengthy volume. However, in order to produce a manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue, and references where more in-depth information is available. Text within each profile was researched from a variety of sources, and was usually condensed from more detailed sources pertaining to specific topics. This approach allows for a wide coverage of activities that can be further explored based upon the citations and references listed at the end of this profile. As a check on the information included, each notebook went through an external review process. The Office of Compliance appreciates the efforts of all those that participated in this process and enabled us to develop more complete, accurate and up-to-date summaries. Many of those who reviewed this notebook are listed as contacts in Section IX and may be sources of additional information. The individuals and groups on this list do not necessarily concur with all statements within this notebook.

I.B. Additional Information

Providing Comments

OECA's Office of Compliance plans to periodically review and update the notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing notebook, or if you would like to provide additional information, please send a hard copy and computer disk to the EPA Office of Compliance, Sector Notebook Project, 401 M St., SW (2223-A), Washington, DC 20460. Comments can also be uploaded to the Enviroene Bulletin Board or the Environ$ense World Wide Web for general access to all users of the system. Follow instructions in Appendix A for accessing these data systems. Once you have logged in, procedures for uploading text are available from the on-line Enviroene Help System.

Adapting Notebooks to Particular Needs

The scope of the existing notebooks reflect an approximation of the relative national occurrence of facility types that occur within each sector. In many instances, industries within specific geographic regions or states may have unique characteristics that are not fully captured in these profiles. For this reason, the Office of Compliance encourages state and local environmental agencies and other groups to supplement or re-package the information included in this notebook to include more specific industrial and regulatory information that may be available. Additionally, interested states may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with state and local requirements. Compliance or technical assistance providers may also want to develop the "Pollution Prevention" section in more detail. Please contact the appropriate specialist listed on the opening page of this notebook if your office is interested in assisting us in the further development of the information or policies addressed within this volume. If you are interested in assisting in the development of new notebooks for sectors not covered in the original eighteen, please contact the Office of Compliance at 202-564-2395.

II. INTRODUCTION TO THE IRON AND STEEL INDUSTRY

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the iron and steel industry. The type of facilities described within the document are also described in terms of their Standard Industrial Classification (SIC) codes. Additionally, this section contains a list of the largest companies in terms of sales.

II.A. Introduction, Background, and Scope of the Notebook

The iron and steel industry is categorized by the Bureau of the Census under the Standard Industrial Classification (SIC) code 33, primary metal industries. The industry is further classified by the three-digit codes 331, Steel Works, Blast Furnaces, and Rolling and Finishing Mills, and 332 Iron and Steel Foundries. Since steel works, blast furnaces, and rolling and finishing mills account for the majority of environmental releases, employees, and value of shipments, this profile concentrates on the three-digit SIC 331. The environmental releases associated with foundries are similar to the steel casting and finishing processes included under SIC 331, therefore SIC 332 will not be addressed in this notebook. Some sections of the profile focus specifically on industries in the four-digit SIC 3312, since virtually all establishments producing primary products (iron and steel) under SIC 3312, also produce secondary products that fall under some of the other iron and steel SIC codes under SIC 331.

II.B. Characterization of the Iron and Steel Industry

II.B.1. Industry Size and Geographic Distribution

There are approximately 1,118 manufacturing facilities under SIC 331 according to *1992 Census of Manufactures* data.[1] The payroll totaled $9.3 billion for a workforce of 241,000 employees, and value of shipments totaled $58 billion. Net shipments of steel mill products for all grades including carbon, alloy, and stainless totaled 92.7 million net tons in 1993[2] and 95.1 million net tons in 1994.[3] In terms of environmental issues, value of shipments, and number of employees, SIC 3312 (Blast Furnaces and Steel Mills), is the most significant four-digit code under SIC 331. The 1992 Census data reported 247 establishments under SIC 3312, with an estimated 172,000 employees, a payroll of $7 billion, and a value of shipments totaling $42 billion. For the same year, the American Iron and Steel Institute estimated 114 companies operated 217 iron and steel facilities; this estimate included any facility with one or more iron or steelmaking operation.[4]

The *1987 Census of Manufactures*[5] further categorizes SIC 3312 by the type of steel mill: integrated or non-integrated. A fully integrated facility produces steel from raw materials of coal, iron ore, and scrap. Non-integrated plants do not have all of the equipment to produce steel from coal, iron ore, and scrap on-site, instead they purchase some of their raw materials in a processed form.

SIC Diversity

The Bureau of the Census categorizes the three- and four-digit SIC codes related to iron and steel as follows:

SIC 331 - Steel works, blast furnaces, coke ovens, rolling and finishing mills
- 3312 - Steel works, blast furnaces, and rolling mills
- 3313 - Electrometallurgical products, except steel
- 3315 - Steel wiredrawing and steel nails and spikes
- 3316 - Cold-rolled steel sheet, strip, and bars
- 3317 - Steel pipe and tubes

The remainder of the industries classified under SIC code 33 cover the ferrous and non-ferrous foundries, and smelting, refining, and shaping of nonferrous metals which are not covered in this profile.

Two Steel Industries

In the past fifteen years, the U.S. steel industry has lost over 61 percent of its employees and 58 percent of its facilities. Slow growth in demand for steel, markets lost to other materials, increased imports, and older, less efficient production facilities are largely to blame for the industry's decline. While the integrated steel industry was contracting, a group of companies, called minimills, more than doubled their capacity in the same period and they continue to expand into new markets. Minimills use electric arc furnaces (EAFs) to melt scrap and other materials to make steel products, instead of using coke, iron ore, and scrap as the integrated producers do. In addition to fundamentally different production technologies, other differences between the integrated steel mills and minimill are also significant: minimills have narrow product lines, they often have small, non-unionized work forces that may receive higher pay per hour than a comparable unionized work force, but without union benefits. Additionally, minimills typically produce much less product per facility (less than 1 million tons of steel per year). Lower scrap prices in the 1960s and 1970s created opportunities for the minimill segment of the market to grow rapidly. Initially, the EAF technology could only be used in the production of low quality long products, such as concrete reinforcing bar, but over the years minimill products have improved in quality and have overcome technological limitations to diversify their product lines. Recently, minimills have entered new markets, such as flat-rolled products, however, more than half of the market for quality steel products still remains beyond minimill capability. The EAF producers do face the problems of fluctuating scrap prices which are more volatile than the prices of raw materials used by integrated producers.

Geographic Distribution

The highest geographic concentration of mills is in the Great Lakes region, where most integrated plants are based (Exhibit 1). According to the *1987 Census of Manufactures*, 46 percent of steel mills are located in six Great Lakes states: New York, Pennsylvania, Ohio, Indiana, Illinois, and Michigan, with a heavy concentration of steel manufacturing in the Chicago area. Approximately 80 percent of the U.S. steelmaking capacity is in these states. The South is the next largest steel-producing region, although there are only two integrated steel plants. Steel production in the western U.S. is limited to one integrated plant and several minimills. Historically, the mill sites were selected for their proximity to water (tremendous amounts are used for cooling and processing, and for transportation) and the sources of their raw materials, iron ore and coal. Traditional steelmaking regions included the Monongahela River valley near Pittsburgh and along the Mahoning River near Youngstown, Ohio. The geographic concentration of the industry continues to change as minimills are built anywhere electricity and scrap are available at a reasonable cost and there is a local market for a single product.

Size Distribution

Large, fully-integrated steel mills have suffered considerably in the last 15 years, largely due to loss of market share to other materials, competition, and the high cost of pension liabilities. In comparing the *1992 Census of Manufacture* data with the data from 1977, these changes are clear. While the number of establishments under SIC 3312 fell by 58 percent from 504 facilities in 1977 to 247 in 1992, the absolute number of integrated mills has always been small, and the reduction is largely due to a drop in the number of small establishments. A more relevant statistic is the reduction in employees during the same time period. The work force for these facilities was dramatically reduced as plants closed or were reorganized by bankruptcy courts. Those that remained open automated and streamlined operations resulting in a 61 percent reduction in the number of production employees over the same 15 year period. Approximately 172,000 were still employed in SIC 3312 establishments in 1992.

The *1987 Census of Manufactures* breaks the SIC code 3312 down into four sub-industries: Fully-integrated (consists of coke ovens, blast furnaces, steel furnaces, and rolling and finishing mills), partially integrated with blast furnace (consists of blast furnaces, steel furnaces, and rolling and finishing mills), partially integrated without blast furnaces (consists of steel furnaces and either rolling and finishing mills or a forging department; includes mini mills), and non-integrated (all others, including stand-alone rolling and finishing mills, and stand-alone coke plants). This division highlights some important characteristics about the size of facilities in this industry. Only 8 percent (20 plants) of the establishments under SIC 3312 in 1987 were fully integrated mills. However, 46 percent of the industry's employees worked in these 20 plants.

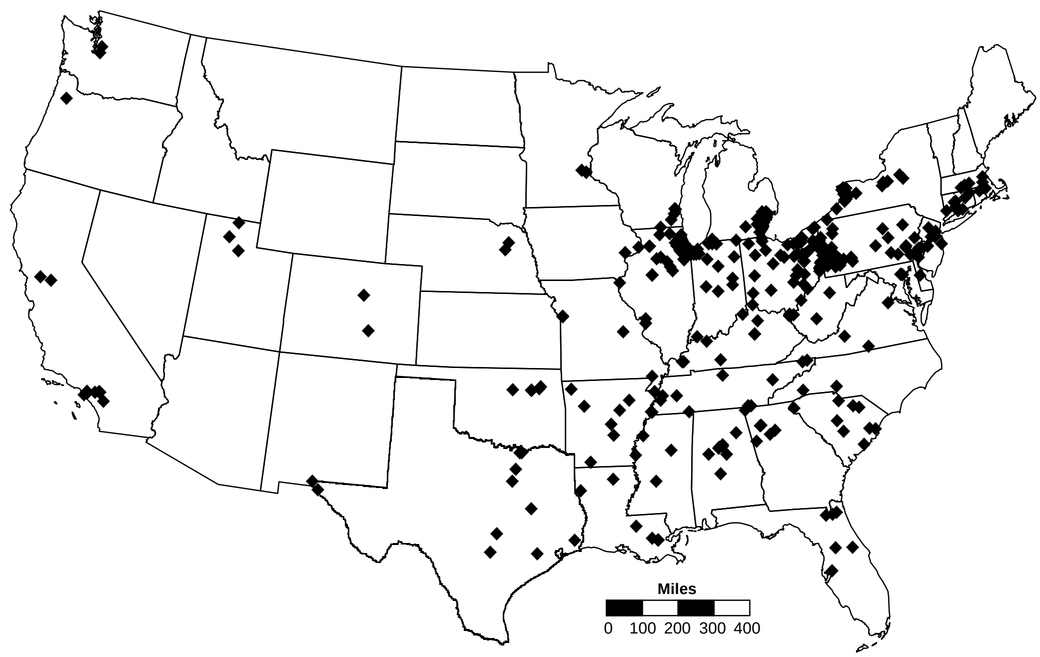


Exhibit 1: Geographic Distribution of SIC 331 Establishments: Steel Works, Blast Furnaces, and Rolling and Finishing Mills

Top Steel Producers

Market Share Reporter, published by Gale Research Inc., annually compiles reported market share data on companies, products, and services. The 1995 edition ranks top U.S. steel producers by 1993 sales in millions of dollars, as shown in Exhibit 2.

Exhibit 2: Top U.S. Iron and Steel Producers

Rank	Company	1993 Sales (millions of dollars)
1	US Steel Group - Pittsburgh, PA	5,422
2	Bethlehem Steel Corp. - Bethlehem, PA	4,219
3	LTV Corp. - Dallas, TX	3,868
4	National Steel Corp. - Pittsburgh, PA	2,418
5	Inland Steel Industries, Inc. - Chicago, IL	2,175
6	Armco Inc. - Parsippany, NJ	1,595
7	Weirton Steel Corp. - Weirton, WV	1,201
8	Wheeling-Pittsburgh Steel - Pittsburgh, PA	1,047

Source: Market Share Reporter, 1995.

II.B.2. Product Characterization

The iron and steel industry produces iron and steel mill products, such as bars, strips, and sheets, as well as formed products such as steel nails, spikes, wire, rods, pipes, and non-steel electrometallurgical products such as ferroalloys. Under SIC 3312, Blast Furnaces and Steel Mills, products also include coke, and products derived from chemical recovery in the coking process such as coal tar and distillates.

Historically, the automotive and construction sectors have been the two largest steel consuming industries. Consequently, fluctuations in sales and choice of materials in these industries have a significant impact on the iron and steel industry. Over the last two decades, the structure of the steelmaking industry has changed dramatically due to new technologies, foreign competition, and loss of market share to other materials. Many of the large, fully-integrated facilities have closed, and those that are still operating, have reduced their workforce, increased automation, and invested in new technologies to remain competitive.

II.B.3. Economic Trends

Domestic Market

After years of collapsing markets, bankruptcies, mill closings and layoffs, the steel industry experienced a turnaround in 1993. Shipments were at their highest level since 1981.[6] For the first time since 1989, steelmakers were able to boost their prices. This increase in demand is due in part to the weak dollar, which makes importing foreign steel more expensive than it used to be. The relatively high level of shipments was also attributable to a strong demand from the steel industry's two largest customers - the automotive and construction sectors.[7] Recently, prices for steel sold to the automotive industry have been set in long-term contracts. The prices set in the automotive contracts tend to influence the steel prices of other contract negotiations, such as those with appliance manufacturers. Overall, more than half of all steel sold in the U.S. is covered by long-term contracts; the rest is sold on the spot market.

International Trade

Problems in international steel trade intensified in the last 5 years due in large part to a worldwide weakening in demand. With the exception of China, where rapid economic growth has led to a steady increase in steel demand, the export market has been weak. The "voluntary restraint arrangements" that limited imports in the 1980s expired in 1992. Since then, the U.S. steel industry has discouraged imports by filing complaints that products are being dumped - sold at less than the cost of production. Similar cases have also been filed against U.S. exporters. To address the problems of unfairly traded steel, most major steel-producing countries have participated in multilateral steel agreement (MSA) negotiations under the General Agreement on Tariffs and Trade (GATT).[8]

Steel imports for 1992 totaled 15.2 million metric tons. From 1989 to 1993, the quantity of steel imported was fairly consistent, from 15.7 million metric tons in 1989 to 15.3 million metric tons estimated for 1993. The exception is a slight dip to 14.3 million metric tons in 1991. The forecast for 1994, at 16.3 million metric tons, is a more significant increase than has been seen in the last five years. The export market has seen slightly more variability over the same time period, with a high of 5.7 million metric tons exported in 1991, and 3.8 million metric tons in exports forecast for 1994.[9]

Labor

According to *1992 Census of Manufactures,* there were an estimated 172,000 people employed in SIC 3312 industries, with a payroll of $7 billion. This was a 61 percent decrease from 1977 levels of 442,000 employees, and a 42% reduction from 1982 levels of 295,000 employees. This dramatic reduction in workforce was primarily due to reductions at the large integrated facilities. For example, the U.S. Steel plant in Gary, Indiana, employed 30,000 people during the plant's peak employment in 1953. In 1992, there were about 8,000 employees working at the 4,000-acre facility.

This reduction in workforce, coupled with investments in new equipment, automation, and management restructuring has resulted in the increased productivity that was essential for integrated mills to remain competitive in the face of the severe competitive pressures both from EAF producers in the U.S. and from abroad. With these changes, the U.S. industry has become one of the lowest-cost producers in the developed world. Productivity in steelmaking is often measured in man-hours per ton of finished steel. For every ton produced, American steelmakers spend 5.3 man-hours, compared with 5.6 for the Japanese and Canadian industries, and 5.7 for the British, French, and Germans. The increase in productivity is also reflected in changes in the value added by manufacture, as reported by the Census. During the ten year period where employment in the industry dropped by 42% (1982 - 1992), the value added by manufacture increased by 39% from $11.8 million in 1982 to $16.5 million in 1992.

Problems from such a sizable workforce reduction persist. The industry says one big cost is "legacy costs" - obligations to pay pensions and health benefits to the tens of thousands of retirees and their spouses. Some integrated companies have five retired workers for every active employee. For many of the large, integrated facilities, these pensions are underfinanced. Of the 50 most underfinanced pension plans, five are in the steel industry. This puts the newer minimills, who do not have such legacy costs, at a clear competitive advantage.

In addition to pension payments, major U.S. steel producers are now paying out an average $5.30 per hour worked, 17 percent of total hourly employment costs, for health care. The industry argues that these high costs place it at a disadvantage with its major foreign competitors, some of whom pay no direct health care expenses.

Long-term Prospects

Production of steel products in 1993 totaled 89.0 million net tons which represents an 89.1 percent capacity utilization. Shipments for 1994 rose to 95.1 million net tons and it is forecasted that demand will stay high, with industry capacity utilization increasing through 1995.[10] After years of losing market share to other materials, steel appears to be regaining a competitive position. In the automotive market, some parts that were recently made of plastic, such as fenders, roofs, and hoods, are being returned to steel. The decades-long downtrend in steel content in automobiles appears to have slowed and recently has actually reversed. According to Ford Motor Company, the average vehicle built in 1993 contained 1,726 pounds of steel, up from 1,710 pounds in 1992, marking the second consecutive yearly increase. A further increase is anticipated in 1994 due to new and expanding applications of steel. In addition to increased orders from the automotive sector, the residential construction sector is a potentially rich market for steel producers. Steel framing for houses is being promoted as a light-weight, high strength alternative to wood framing. A galvanized steel frame for a 2,000 square foot house would weigh approximately one-fourth the weight of a lumber structure.

III. INDUSTRIAL PROCESS DESCRIPTION

This section describes the major industrial processes within the iron and steel industry, including the materials and equipment used, and the processes employed. The section is designed for those interested in gaining a general understanding of the industry, and for those interested in the inter-relationship between the industrial process and the topics described in subsequent sections of this profile -- pollutant outputs, pollution prevention opportunities, and Federal regulations. This section does not attempt to replicate published engineering information that is available for this industry. Refer to Section IX for a list of reference documents that are available.

This section specifically contains a description of commonly used production processes, associated raw materials, the byproducts produced or released, and the materials either recycled or transferred off-site. This discussion, coupled with schematic drawings of the identified processes, provide a concise description of where wastes may be produced in the process. This section also describes the potential fate (via air, water, and soil pathways) of these waste products.

III.A. Industrial Processes in the Iron and Steel Industry

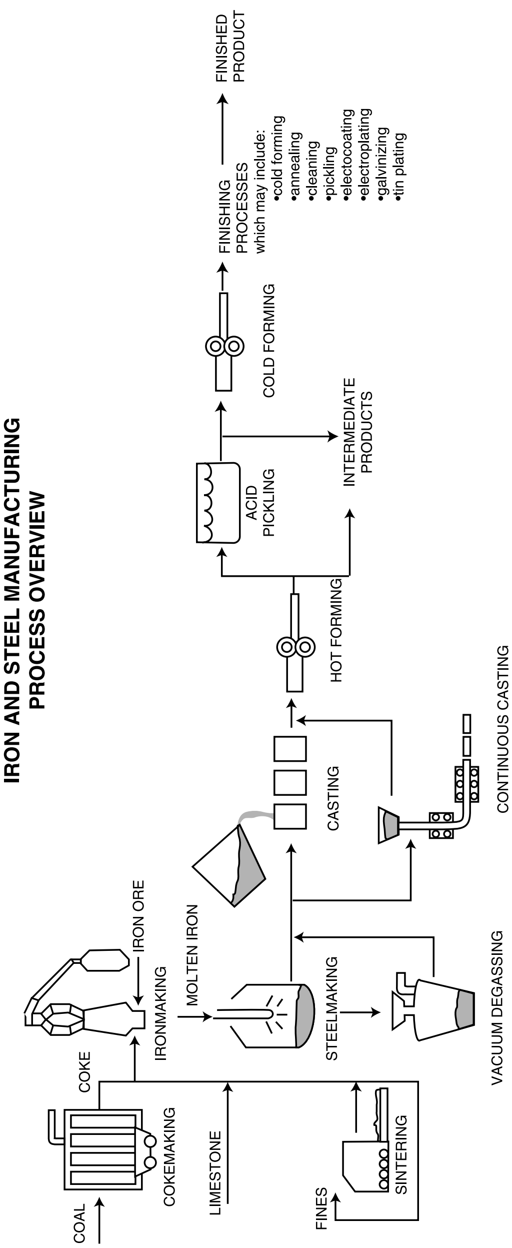
In view of the high cost of most new equipment and the relatively long lead time necessary to bring new equipment on line in the steel industry, changes in production methods and products in the steel industry are typically made gradually. Installation of major pieces of new steelmaking equipment may cost millions of dollars and require additional retrofitting of other equipment. Even new process technologies that fundamentally improve productivity, such as the continuous casting process (described below), are adopted only over long periods of time. Given the recent financial performance of the steel industry, the ability to raise the capital needed to purchase such equipment is limited.

Environmental legislation is challenging the industry to develop cleaner and more efficient steelmaking processes at the same time competition from substitute materials are forcing steelmakers to invest in cost-saving and quality enhancing technologies. In the long term, the steel industry will likely continue to move towards more simplified and continuous manufacturing technologies that reduce the capital costs for new mill construction and allow smaller mills to operate efficiently. The companies that excel will be those that have the resources and foresight to invest in such technologies.

Steel is an alloy of iron usually containing less than one percent carbon. The process of steel production occurs in several sequential steps (Exhibit 3). The two types of steelmaking technology in use today are the basic oxygen furnace (BOF) and the electric arc furnace (EAF). Although these two technologies use different input materials, the output for both furnace types is molten steel which is subsequently formed into steel mill products. The BOF input materials are molten iron, scrap, and oxygen. In the EAF, electricity and scrap are the input materials used. BOFs are typically used for high tonnage production of carbon steels, while EAFs are used to produce carbon steels and low tonnage alloy and specialty steels. The processes leading up to steelmaking in a BOF are very different than the steps preceeding steelmaking in an EAF; the steps after each of these processes producing molten steel are the same.

When making steel using a BOF, cokemaking and ironmaking precede steelmaking; these steps are not needed for steelmaking with an EAF. Coke, which is the fuel and carbon source, is produced by heating coal in the absence of oxygen at high temperatures in coke ovens. Pig iron is then produced by heating the coke, iron ore, and limestone in a blast furnace. In the BOF, molten iron from the blast furnace is combined with flux and scrap steel where high-purity oxygen is injected. This process, with cokemaking, ironmaking, steelmaking, and subsequent forming and finishing operations is referred to as fully integrated production. Alternatively, in an EAF, the input material is primarily scrap steel, which is melted and refined by passing an electric current from the electrodes through the scrap. The molten steel from either process is formed into ingots or slabs that are rolled into finished products. Rolling operations may require reheating, rolling, cleaning, and coating the steel. A description of both steelmaking processes follows:

EXHIBIT 3
IRON AND STEEL MANUFACTURING
PROCESS OVERVIEW



III.A.1. Steelmaking Using the Basic Oxygen Furnace

The process of making steel in a Basic Oxygen Furnace (BOF) is preceded by cokemaking and ironmaking operations. In cokemaking, coke is produced from coal. In ironmaking, molten iron is produced from iron ore and coke. Each of these processes and the subsequent steelmaking process in the BOF are described below.

Cokemaking

Coal processing in the iron and steel industry typically involves producing coke, coke gas and by-product chemicals from compounds released from the coal during the cokemaking process (Exhibit 4). Coke is carbon-rich and is used as a carbon source and fuel to heat and melt iron ore in ironmaking. The cokemaking process starts with bituminous pulverized coal charge which is fed into the coke oven through ports in the top of the oven. After charging, the oven ports are sealed and the coal is heated at high temperatures (1600 to 2300°F) in the absence of oxygen. Coke manufacturing is done in a batch mode where each cycle lasts for 14 to 36 hours. A coke oven battery comprises a series of 10 to 100 individual ovens, side-by-side, with a heating flue between each oven pair. Volatile compounds are driven from the coal, collected from each oven, and processed for recovery of combustible gases and other coal byproducts.[11] The solid carbon remaining in the oven is the coke. The necessary heat for distillation is supplied by external combustion of fuels (e.g., recovered coke oven gas, blast furnace gas) through flues located between ovens.[12] At the end of the heating cycle, the coke is pushed from the oven into a rail quench car. The quench car takes it to the quench tower, where the hot coke is cooled with a water spray. The coke is then screened and sent to the blast furnace or to storage.

In the by-products recovery process, volatile components of the coke oven gas stream are recovered including the coke oven gas itself (which is used as a fuel for the coke oven), naphthalene, ammonium compounds, crude light oils, sulfur compounds, and coke breeze (coke fines). During the coke quenching, handling, and screening operation, coke breeze is produced. Typically, the coke breeze is reused in other manufacturing processes on-site (e.g., sintering) or sold off-site as a by-product.[13]

The cokemaking process is seen by industry experts as one of the steel industry's areas of greatest environmental concern, with air emissions and quench water as major problems. In efforts to reduce the emissions associated with cokemaking, U.S. steelmakers are turning to technologies such as pulverized coal injection, which substitutes coal for coke in the blast furnace. Use of pulverized coal injection can replace about 25 to 40 percent of coke in the blast furnace, reducing the amount of coke required and the associated emissions. Steel producers also inject other fuels, such as natural gas, oil, and tar/pitch to replace a portion of the coke.

Quench water from cokemaking is also an area of significant environmental concern. In Europe, some plants have implemented technology to shift from water quenching to dry quenching which eliminates suspected carcinogenic particulates and VOCs. However, major construction changes are required for such a solution and considering the high capital costs of coke batteries, combined with the depressed state of the steel industry and increased regulations for cokemaking, it is unlikely that new facilities will be constructed. Instead, industry experts expect to see an increase in the amount of coke imported.

Ironmaking

In the blast furnace, molten iron is produced (Exhibit 4). Iron ore, coke, and limestone are fed into the top of the blast furnace. Heated air is forced into the bottom of the furnace through a bustle pipe and tuyeres (orifices) located around the circumference of the furnace. The carbon monoxide from the burning of the coke reduces iron ore to iron. The acid part of the ores reacts with the limestone to create a slag which is drawn periodically from the furnace. This slag contains unwanted impurities in the ore, such as sulfur from the fuels. When the furnace is tapped, iron is removed through one set of runners and molten slag via another. The molten iron is tapped into refractory-lined cars for transport to the steelmaking furnaces. Residuals from the process are mainly sulfur dioxide or hydrogen sulfide, which are driven off from the hot slag. The slag is the largest by-product generated from the ironmaking process and is reused extensively in the construction industry.[14] Blast furnace flue gas is cleaned and used to generate steam to preheat the air coming into the furnace, or it may be used to supply heat to other plant processes. The cleaning of the gas may generate air pollution control dust in removing coarse particulates (which may be reused in the sintering plant or landfilled), and water treatment plant sludge in removing fine particulates by venturi scrubbers.

Sintering is the process that agglomerates fines (including iron ore fines, pollution control dusts, coke breeze, water treatment plant sludge, coke breeze, and flux) into a porous mass for charging to the blast furnace.[15] Through sintering operations, a mill can recycle iron-rich material, such as mill scale and processed slag. Not all mills have sintering capabilities. The input materials are mixed together, placed on a slow-moving grate and ignited. Windboxes under the grate draw air through the materials to deepen the combustion throughout the traveling length of the grate. The coke breeze provides the carbon source for sustaining the controlled combustion. In the process, the fine materials are fused into the sinter agglomerates, which can be reintroduced into the blast furnace along with ore. Air pollution control equipment removes the particulate matter generated during the thermal fusing process. For wet scrubbers, water treatment plant sludge are generally land disposed waste. If electrostatic precipitators or baghouses are used as the air pollution control equipment, the dry particulates captured are typically recycled as sinter feedstock, or are landfilled as solid waste.

Steelmaking Using the Basic Oxygen Furnace

Molten iron from the blast furnace, flux, alloy materials, and scrap are placed in the basic oxygen furnace, melted and refined by injecting high-purity oxygen. A chemical reaction occurs, where the oxygen reacts with carbon and silicon generating the heat necessary to melt the scrap and oxidize impurities. This is a batch process with a cycle time of about 45 minutes. Slag is produced from impurities removed by the combination of the fluxes with the injected oxygen. Various alloys are added to produce different grades of steel. The molten steel is typically cast into slabs, beams or billets.

The waste products from the basic oxygen steelmaking process include slag, carbon monoxide, and oxides of iron emitted as dust. Also, when the hot iron is poured into ladles or the furnace, iron oxide fumes are released and some of the carbon in the iron is precipitated as graphite (kish). The BOF slag can be processed to recover the high metallic portions for use in sintering or blast furnaces, but its applications as a saleable construction materials are more limited than the blast furnace slag.

Basic oxygen furnaces are equipped with air pollution control systems for containing, cooling, and cleaning the volumes of hot gases and sub-micron fumes that are released during the process. Water is used to quench or cool the gases and fumes to temperatures at which they can be effectively treated by the gas cleaning equipment. The resulting waste streams from the pollution control processes include air pollution control dust and water treatment plant sludge. About 1,000 gallons of water per ton of steel (gpt) are used for a wet scrubber. The principal pollutants removed from the off-gas are total suspended solids and metals (primarily zinc, and some lead).[16]

EXHIBIT 4
IRON AND STEEL MANUFACTURING
COKEMAKING AND IRONMAKING

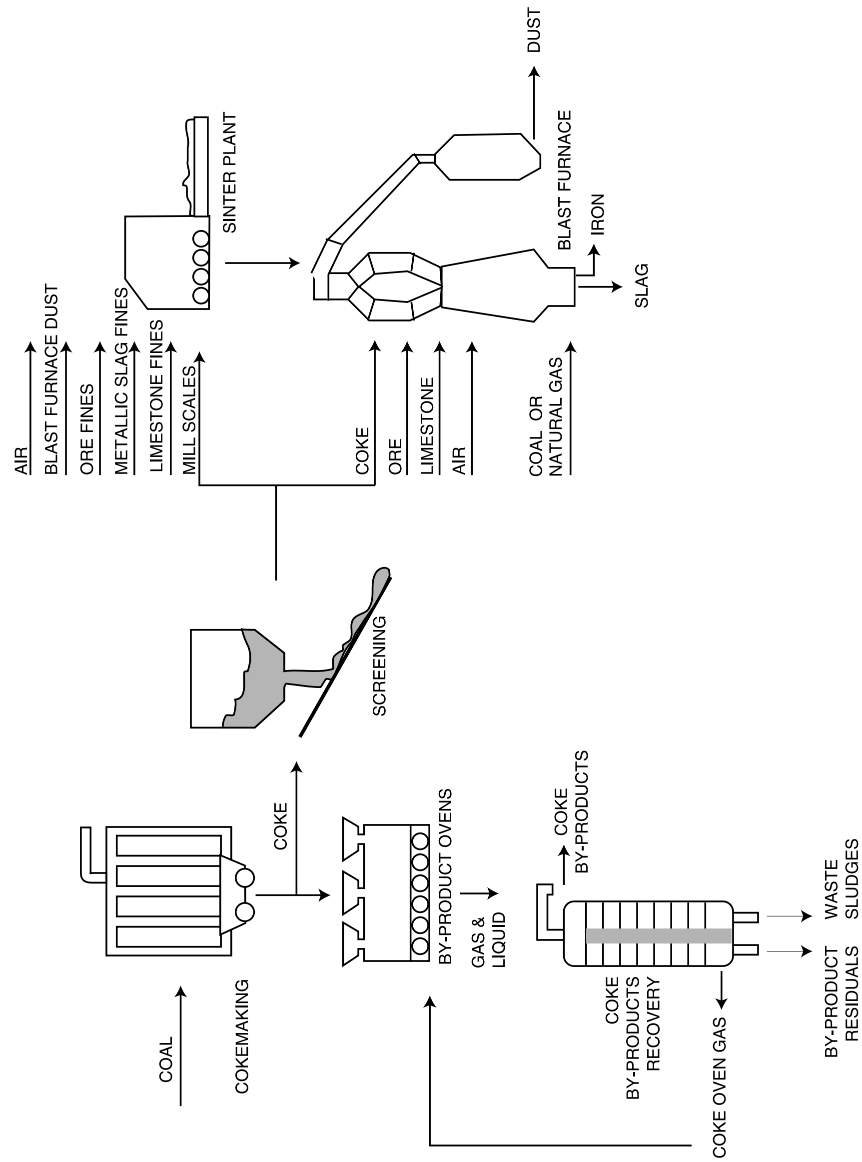
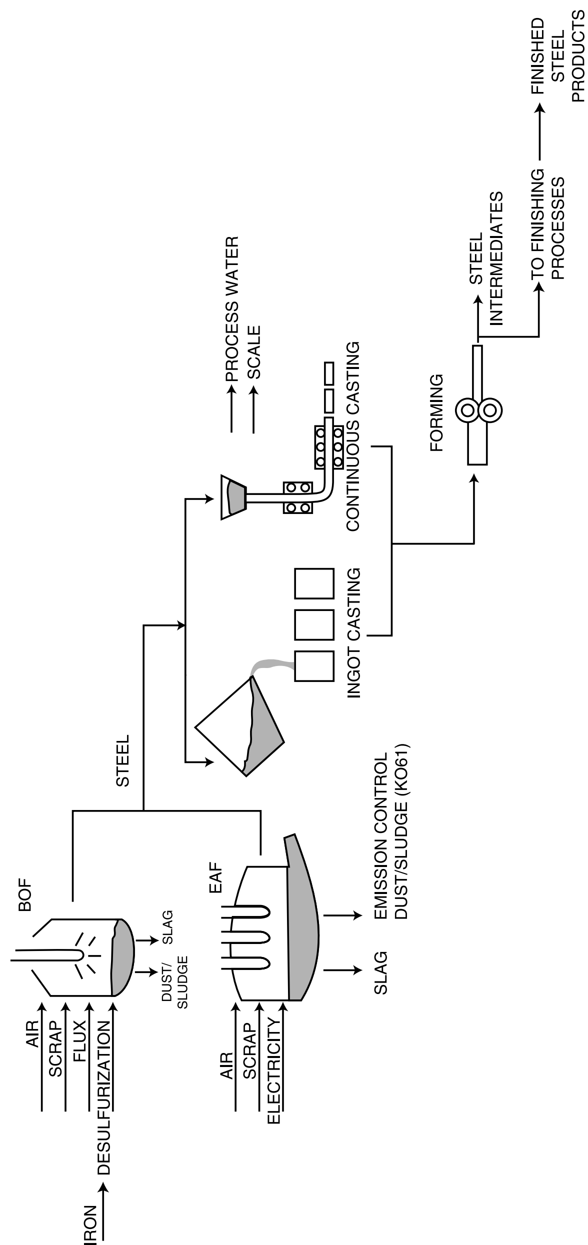


EXHIBIT 5
IRON AND STEEL MANUFACTURING
STEELMAKING



III.A.2. Steelmaking Using the Electric Arc Furnace (EAF)

In the steelmaking process that uses an electric arc furnace (EAF), the primary raw material is scrap metal, which is melted and refined using electric energy. During melting, oxidation of phosphorus, silicon, manganese, carbon and other materials occurs and a slag containing some of these oxidation products forms on top of the molten metal.[17] Oxygen is used to decarburize the molten steel and to provide thermal energy. This is a batch process with a cycle time of about two to three hours. Since scrap metal is used instead of molten iron, there are no cokemaking or ironmaking operations associated with steel production that uses an EAF.

The process produces metal dusts, slag, and gaseous products. Particulate matter and gases evolve together during the steelmaking process and are conveyed into a gas cleaning system. These emissions are cleaned using a wet or dry system. The particulate matter that is removed as emissions in the dry system is referred to as EAF dust, or EAF sludge if it is from a wet system and it is a listed hazardous waste (RCRA K061). The composition of EAF dust can vary greatly depending on the scrap composition and furnace additives. The primary component is iron or iron oxides, and it may also contain flux (lime and/or fluorspar), zinc, chromium and nickel oxides (when stainless steel is being produced) and other metals associated with the scrap. The two primary hazardous constituents of EAF emission control dust are lead and cadmium.[18] Generally, 20 pounds of dust per ton of steel is expected, but as much as 40 pounds of dust per ton of steel may be generated, depending on production practices.[19] Oils are burned off "charges" of oil-bearing scrap in the furnace. Minor amounts of nitrogen oxides and ozone are generated during the melting process. The furnace is extensively cooled by water; however, this water is recycled through cooling towers.

III.A.3. Forming and Finishing Operations

Whether the molten steel is produced using a BOF or an EAF, to convert it into a product, it must be solidified into a shape suitable and finished.

Forming

The traditional forming method, called ingot teeming, has been to pour the metal into ingot molds, allowing the steel to cool and solidify. The alternative method of forming steel, called continuous casting accounted for more 86% of raw steel produced in the U.S. in 1992[20], compared with approximately 30 percent in 1982. The continuous casting process bypasses several steps of the conventional ingot teeming process by casting steel directly into semifinished shapes. Molten steel is poured into a reservoir from which it is released into the molds of the casting machine. The metal is cooled as it descends through the molds, and before emerging, a hardened outer shell is formed. As the semifinished shapes proceed on the runout table, the center also solidifies, allowing the cast shape to be cut into lengths.

Process contact water cools the continuously cast steel and is collected in settling basins along with oil, grease, and mill scale generated in the casting process. The scale settles out and is removed and recycled for sintering operations, if the mill has a Sinter Plant. Waste treatment plant sludge is also generated.[21]

The steel is further processed to produce slabs, strips, bars, or plates through various forming operations. The most common hot forming operation is hot rolling, where heated steel is passed between two rolls revolving in opposite directions. Modern hot rolling units may have as many as 13 stands, each producing an incremental reduction in thickness. The final shape and characteristics of a hot formed piece depend on the rolling temperature, the roll profile, and the cooling process after rolling. Wastes generated from hot rolling include waste treatment plant sludge and scale.

In subsequent cold forming, the cross-sectional area of unheated steel is progressively reduced in thickness as the steel passes through a series of rolling stands. Generally, wires, tubes, sheet and strip steel products are produced by cold rolling operations. Cold forming is used to obtain improved mechanical properties, better machinability, special size accuracy, and the production of thinner gages than hot rolling can accomplish economically.[22] During cold rolling, the steel becomes hard and brittle. To make the steel more ductile, it is heated in an annealing furnace.

Process contact water is used as a coolant for rolling mills to keep the surface of the steel clean between roller passes. Cold rolling operations also produce a waste treatment plant sludge, primarily due to the lubricants applied during rolling. Grindings from resurfacing of the worn rolls and disposal of used rolls can be a significant contributor to the plant's wastestream.

Finishing
One of the most important aspects of a finished product is the surface quality. To prevent corrosion, a protective coating may be applied to the steel product. Prior to coating, the surface of the steel must be cleaned so the coating will adhere to the steel. Mill scale, rust, oxides, oil, grease, and soil are chemically removed from the surface of steel using solvent cleaners, pressurized water or air blasting, cleaning with abrasives, alkaline agents or acid pickling. In the pickling process, the steel surface is chemically cleaned of scale, rust, and other materials. Inorganic acids such as hydrochloric or sulfuric acid are most commonly used for pickling. Stainless steels are pickled with hydrochloric, nitric, and hydrofluoric acids. Spent pickle liquor may be a listed hazardous waste (RCRA K062), if it contains considerable residual acidity and high concentrations of dissolved iron salts. Pickling prior to coating may use a mildly acidic bath which is not considered K062.

Steel generally passes from the pickling bath through a series of rinses. Alkaline cleaners may also be used to remove mineral oils and animal fats and oils from the steel surface prior to cold rolling. Common alkaline cleaning agents include: caustic soda, soda ash, alkaline silicates, phosphates.

Steel products are often given a coating to inhibit oxidation and extend the life of the product. Coated products can also be painted to further inhibit corrosion. Common coating processes include: galvanizing (zinc coating), tin coating, chromium coating, aluminizing, and terne coating (lead and tin). Metallic coating application processes include hot dipping, metal spraying, metal cladding (to produce bi-metal products), and electroplating. Galvanizing is a common coating process where a thin layer of zinc is deposited on the steel surface.

III.B. Raw Material Inputs and Pollution Outputs

Numerous outputs are produced as a result of the manufacturing of coke, iron, and steel, the forming of metals into basic shapes, and the cleaning and scaling of metal surfaces. These outputs, categorized by process (RCRA waste code provided where applicable), include:

Cokemaking

Inputs:
- Coal, heat, quench water

Outputs:
- Process residues from coke by-product recovery (RCRA K143, K148)
- Coke oven gas by-products such as coal tar, light oil, ammonia liquor, and the remainder of the gas stream is used as fuel. Coal tar is typically refined to produce commercial and industrial products including pitch, creosote oil, refined tar, naphthalene, and bitumen.
- Charging emissions (fine particles of coke generated during oven pushing, conveyor transport, loading and unloading of coke that are captured by pollution control equipment. Approximately one pound per ton of coke produced are captured and generally land disposed).
- Ammonia, phenol, cyanide and hydrogen sulfide
- Oil (K143 and K144)
- Lime sludge, generated from the ammonia still (K060)
- Decanter tank tar sludge (K087)
- Benzene releases in coke by-product recovery operations
- Naphthalene residues, generated in the final cooling tower
- Tar residues (K035, K141, K142, and K147)
- Sulfur compounds, emitted from the stacks of the coke ovens
- Wastewater from cleaning and cooling (contains zinc, ammonia still lime (K060), or decanter tank tar (K087), tar distillation residues (K035))
- Coke oven gas condensate from piping and distribution system; may be a RCRA characteristic waste for benzene.

Ironmaking

Inputs:
- Iron ore (primarily in the form of taconite pellets), coke, sinter, coal, limestone, heated air

Outputs:

- Slag, which is either sold as a by-product, primarily for use in the construction industry, or landfilled
- Residual sulfur dioxide or hydrogen sulfide
- Particulates captured in the gas, including the air pollution control (APC) dust or waste treatment plant (WTP) sludge
- Iron is the predominant metal found in the process wastewater
- Blast furnace gas (CO)

Steelmaking

Inputs:

- In the steelmaking process that uses a basic oxygen furnace (BOF), inputs include molten iron, metal scrap, and high-purity oxygen
- In the steelmaking process that uses an electric arc furnace (EAF), the primary inputs are scrap metal, electric energy and graphite electrodes.
- For both processes, fluxes and alloys are added, and may include: fluorspar, dolomite, and alloying agents such as aluminum, manganese, and others.

Outputs:

- Basic Oxygen Furnace emission control dust and sludge, a metals-bearing waste.
- Electric Arc Furnace emission control dust and sludge (K061); generally, 20 pounds of dust per ton of steel is expected, but as much as 40 pounds of dust per ton of steel may be generated depending on the scrap that is used.
- Metal dusts (consisting of iron particulate, zinc, and other metals associated with the scrap and flux (lime and/or fluorspar)) not associated with the EAF.
- Slag.
- Carbon monoxide.
- Nitrogen oxides and ozone, which are generated during the melting process.

Forming, Cleaning, and Descaling

Inputs:

- Carbon steel is pickled with hydrochloric or sulfuric acid; stainless steels are pickled with hydrochloric, nitric, and hydrofluoric acids.
- Various organic chemicals are used in the pickling process.
- Alkaline cleaners may also be used to remove mineral oils and animal fats and oils from the steel surface. Common alkaline cleaning agents include: caustic soda, soda ash, alkaline silicates, phosphates.

Outputs:

- Wastewater sludge from rolling, cooling, descaling, and rinsing operations which may contain cadmium (D006), chromium (D007), lead (D008)
- Oils and greases from hot and cold rolling
- Spent pickle liquor (K062)
- Spent pickle liquor rinse water sludge from cleaning operations
- Wastewater from the rinse baths. Rinse water from coating processes may contain zinc, lead, cadmium, or chromium.
- Grindings from roll refinishing may be RCRA characteristic waste from chromium (D007)
- Zinc dross

III.C. Management of Chemicals in the Production Process

The Pollution Prevention Act of 1990 (PPA) requires facilities to report information about the management of TRI chemicals in waste and efforts made to eliminate or reduce those quantities. These data have been collected annually in Section 8 of the TRI reporting Form R beginning with the 1991 reporting year. The data summarized below cover the years 1992-1995 and is meant to provide a basic understanding of the quantities of waste handled by the industry, the methods typically used to manage this waste, and recent trends in these methods. TRI waste management data can be used to assess trends in source reduction within individual industries and facilities, and for specific TRI chemicals. This information could then be used as a tool in identifying opportunities for pollution prevention compliance assistance activities.

From the yearly data presented below it is apparent that the portion of TRI wastes reported as recycled on-site has increased and the portions treated or managed through energy recovery on-site have decreased between 1992 and 1995 (projected). While the quantities reported for 1992 and 1993 are estimates of quantities already managed, the quantities reported for 1994 and 1995 are projections only. The PPA requires these projections to encourage facilities to consider future waste generation and source reduction of those quantities as well as movement up the waste management hierarchy. Future-year estimates are not commitments that facilities reporting under TRI are required to meet.

Exhibit 6 shows that the iron and steel industry managed about 1.3 billion pounds of production-related waste (total quantity of TRI chemicals in the waste from routine production operations) in 1993 (column B). Column C reveals that of this production-related waste, over half (52%) was either transferred off-site or released to the environment, and most of this quantity was recycled off-site (typically in a metals recovery process). Column C is calculated by dividing the total TRI transfers and releases by the total quantity of production-related waste. In other words, about 48% of the industry's TRI wastes were managed on-site through recycling, energy recovery, or treatment as shown in columns E, F and G, respectively. The majority of waste that is released or transferred off-site can be divided into portions that are recycled off-site, recovered for energy off-site, or treated off-site as shown in columns H, I and J, respectively. The remaining portion of the production related wastes (15% for 1993), shown in column D, is either released to the environment through direct discharges to air, land, water, and underground injection, or it is disposed off-site.

Exhibit 6: Source Reduction and Recycling Activity for Iron and Steel Industry (SIC 331) as Reported within TRI

A	B	C	D	On-Site			Off-Site		
				E	F	G	H	I	J
Year	Quantity of Production-Related Waste (10^6 lbs.)[a]	% Released and Transferred[b]	% Released and Disposed[c] Off-site	% Recycled	% Energy Recovery	% Treated	% Recycled	% Energy Recovery	% Treated
1992	1,301	40%	10%	32%	2%	16%	34%	1%	5%
1993	1,340	52%	15%	24%	1%	17%	35%	1%	6%
1994	1,341	---	15%	23%	1%	18%	37%	1%	6%
1995	1,357	---	15%	22%	1%	18%	38%	1%	6%

[a] Does not include any accidental, non-production related wastes.
[b] Total TRI transfers and releases as reported in Section 5 and 6 of Form R as a percentage of production related wastes; this value may not equal the sum of the percentages released and transferred due to reporting errors in Section 8.
[c] Percentage of production related waste released to the environment and transferred off-site for disposal.

IV. CHEMICAL RELEASE AND TRANSFER PROFILE

This section is designed to provide background information on the pollutant releases that are reported by this industry. The best source of comparative pollutant release information is the Toxic Release Inventory System (TRI). Pursuant to the Emergency Planning and Community Right-to-Know Act, TRI includes self-reported facility release and transfer data for over 600 toxic chemicals. Facilities within SIC Codes 20-39 (manufacturing industries) that have more than 10 employees, and that are above weight-based reporting thresholds are required to report TRI on-site releases and off-site transfers. The information presented within the sector notebooks is derived from the most recently available (1993) TRI reporting year (which then included 316 chemicals), and focuses primarily on the on-site releases reported by each sector. Because TRI requires consistent reporting regardless of sector, it is an excellent tool for drawing comparisons across industries.

Although this sector notebook does not present historical information regarding TRI chemical releases, please note that in general, toxic chemical releases reported in TRI have been declining. In fact, according to the 1993 Toxic Release Inventory Data Book, reported releases dropped by 42.7% between 1988 and 1993. Although on-site releases have decreased, the total amount of reported toxic waste has not declined because the amount of toxic chemicals transferred off-site has increased. Transfers have increased from 3.7 billion pounds in 1991 to 4.7 billion pounds in 1993. Better management practices have led to increases in off-site transfers of toxic chemicals for recycling. More detailed information can be obtained from EPA's annual Toxics Release Inventory Public Data Release book (which is available through the EPCRA Hotline at 1-800-535-0202), or directly from the Toxic Release Inventory System database (for user support call 202-260-1531).

Wherever possible, the sector notebooks present TRI data as the primary indicator of chemical release within each industrial category. TRI data provide the type, amount and media receptor of each chemical released or transferred. When other sources of pollutant release data have been obtained, these data have been included to augment the TRI information.

TRI Data Limitations

The reader should keep in mind the following limitations regarding TRI data. Within some sectors, the majority of facilities are not subject to TRI reporting because they are not considered manufacturing industries, or because they are below TRI reporting thresholds. Examples are the mining, dry cleaning, printing, and transportation equipment cleaning sectors. For these sectors, release information from other sources has been included.

The reader should also be aware that TRI "pounds released" data presented within the notebooks is not equivalent to a "risk" ranking for each industry. Weighting each pound of release equally does not factor in the relative toxicity of each chemical that is released. The Agency is in the process of developing an approach to assign toxicological weightings to each chemical released so that one can differentiate between pollutants with significant differences in toxicity. As a preliminary indicator of the environmental impact of the industry's most commonly released chemicals, the notebook briefly summarizes the toxicological properties of the top five chemicals (by weight) reported by each industry.

Definitions Associated With Section IV Data Tables

General Definitions

SIC Code -- is the Standard Industrial Classification (SIC) is a statistical classification standard used for all establishment-based Federal economic statistics. The SIC codes facilitate comparisons between facility and industry data.

TRI Facilities -- are manufacturing facilities that have 10 or more full-time employees and are above established chemical throughput thresholds. Manufacturing facilities are defined as facilities in Standard Industrial Classification primary codes 20-39. Facilities must submit estimates for all chemicals that are on the EPA's defined list and are above throughput thresholds.

Data Table Column Heading Definitions

The following definitions are based upon standard definitions developed by EPA's Toxic Release Inventory Program. The categories below represent the possible pollutant destinations that can be reported.

RELEASES -- are an on-site discharge of a toxic chemical to the environment. This includes emissions to the air, discharges to bodies of water, releases at the facility to land, as well as contained disposal into underground injection wells.

Releases to Air (Point and Fugitive Air Emissions) -- Include all air emissions from industry activity. Point emission occur through confined air streams as found in stacks, ducts, or pipes. Fugitive emissions include losses from equipment leaks, or evaporative losses from impoundments, spills, or leaks.

Releases to Water (Surface Water Discharges) -- encompass any releases going directly to streams, rivers, lakes, oceans, or other bodies of water. Any estimates for storm water runoff and non-point losses must also be included.

Releases to Land -- includes disposal of toxic chemicals in waste to on-site landfills, land treated or incorporation into soil, surface impoundments, spills, leaks, or waste piles. These activities must occur within the facility's boundaries for inclusion in this category.

Underground Injection -- is a contained release of a fluid into a subsurface well for the purpose of waste disposal.

TRANSFERS -- is a transfer of toxic chemicals in wastes to a facility that is geographically or physically separate from the facility reporting under TRI. The quantities reported represent a movement of the chemical away from the reporting facility. Except for off-site transfers for disposal, these quantities do not necessarily represent entry of the chemical into the environment.

Transfers to POTWs -- are wastewaters transferred through pipes or sewers to a publicly owned treatments works (POTW). Treatment and chemical removal depend on the chemical's nature and treatment methods used. Chemicals not treated or destroyed by the POTW are generally released to surface waters or landfilled within the sludge.

Transfers to Recycling -- are sent off-site for the purposes of regenerating or recovering still valuable materials. Once these chemicals have been recycled, they may be returned to the originating facility or sold commercially.

Transfers to Energy Recovery -- are wastes combusted off-site in industrial furnaces for energy recovery. Treatment of a chemical by incineration is not considered to be energy recovery.

Transfers to Treatment -- are wastes moved off-site for either neutralization, incineration, biological destruction, or physical separation. In some cases, the chemicals are not destroyed but prepared for further waste management.

Transfers to Disposal -- are wastes taken to another facility for disposal generally as a release to land or as an injection underground.

IV.A. EPA Toxic Release Inventory for the Iron and Steel Industry

This section summarizes TRI data of facilities involved in the production of iron and steel products who report their operations under SIC 331. These include blast furnaces and steel mills, steel wire manufacture, and cold rolled steel products but also include a small number of nonferrous operations (such as facilities manufacturing nonferrous electrometalurgical products under SIC 3313). The *Census of Manufactures* reports 1,118 iron and steel establishments under SIC 331. Although 381 iron and steel facilities filed TRI reports in 1993 (under SIC 3312, 3313, 3315, 3316, 3317), the 155 facilities (41 percent) classified under SIC 3312 (blast furnaces and steel mills) are responsible for over 75 percent of reported releases and transfers. TRI information is likely to provide a fairly different profile for the facilities not reporting under 3312 (non-steel producing facilities).

According to TRI data, the iron and steel industry released and transferred a total of approximately 695 million pounds of pollutants during calendar year 1993. These releases and transfers are dominated by large volumes of metal-bearing wastes. The majority of these wastes (70 percent or 488 million pounds) are transferred off-site for recycling, typically for recovery of the metal content. *Transfers* of TRI chemicals account for 86 percent of the iron and steel industry's total TRI-reportable chemicals (609 million pounds) while *releases* make up 14 percent (85 million pounds). Metal-bearing wastes account for approximately 80 percent of the industry's transfers and over fifty percent of the releases.

Releases from the industry continue to decrease, while transfers increased from 1992 to 1993. The increase in transfers is likely due to increased off-site shipments for recovery of metals from wastes. This shift may also have contributed to the decrease in releases. Another factor influencing an overall downward trend since 1988 in releases and transfers is the steel mill production decrease during the 1988 to 1993 period. In addition, pollution control equipment and a shift to new technologies, such as continuous casting, are responsible for significant changes in the amount and type of pollutants released during steelmaking. Finally, the industry's efforts in pollution preventing also play a role in driving pollutant release reductions.

Evidence of the diversity of processes at facilities reporting to TRI is found in the fact that the most frequently reported chemical (sulfuric acid) is reported by only 41 percent of the facilities; the sixth most frequently reported chemical was used by just one-fourth of TRI facilities. The variability in facilities' pollutant profile may be attributable to a number of factors. Fewer than 30 of the facilities in the TRI database for SIC 331 are fully integrated plants making coke, iron, and steel products. The non-integrated facilities do not perform one or more of the production steps and, therefore, may have considerably different emissions profiles. Furthermore, steel making operations with electric arc furnaces have significantly different pollutant profiles than those making steel with basic oxygen furnaces.

Releases

The iron and steel industry releases just 14 percent of its TRI total poundage. Of these releases, over half go to on-site land disposal, and one quarter of releases are fugitive or point source air emissions (Exhibit 7). Manganese, zinc, chromium, and lead account for over 90 percent of the on-site land disposal. The industry's air releases are associated with volatilization, fume or aerosol formation in the high temperature furnaces and byproduct processing. Ammonia, lighter weight organics, such as methanol, acids and metal contaminants found in the iron ore are the principal types of chemicals released to the air. In addition to air releases of chemicals reported in TRI, the iron and steel industry is a significant source of particulates, carbon monoxide, nitrogen oxides and sulfur compounds due to combustion. Ammonia releases account for the largest part of the fugitive releases (approximately 42 percent) and 1,1,1-trichloroethane, hydrochloric acid, zinc compounds, and trichloroethylene each contribute another 4 - 5 percent. Underground injection (principally of hydrochloric acid) makes up about 14 percent of the releases reported by the industry.

Transfers

Eighty percent of transfers reported by SIC 331 industries are sent off-site for recycling. Zinc, manganese, chromium, copper, nickel, and lead are the six metals transferred by the greatest number of facilities (Exhibit 8).

Acids used during steel finishing, such as hydrochloric, sulfuric, nitric, and phosphoric acids, account for another 17 percent of transfers. These acids are most often sent off-site for recycling or for treatment. Hydrochloric acids are also managed by on-site underground injection. The next class of chemicals of significant volume in TRI are solvents and lightweight carbon byproducts, including: 1,1,1-trichloroethane, trichloroethylene, phenol, xylene, methanol, and toluene. These solvents are primarily released as fugitive air emissions, but also from point sources. A small percentage of these solvents are transferred off-site for recycling.

Chemicals sent off-site for disposal (primarily zinc, sulfuric acid, manganese, and ammonium sulfate) account for another 10 percent of transfers. Only approximately 7 percent of chemicals transferred off-site go to treatment. These chemicals are primarily hydrochloric acid, sulfuric acid, and nitric acid. Only about one percent of transfers by weight are POTW discharges (mainly sulfuric acid). Another one percent of transfers are sent for energy recovery (with hydrochloric acid as the most significant contributor).

Exhibit 7: Releases for Iron and Steel Facilities (SIC 331) in TRI, by Number of Facilities Reporting (1993 Releases reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	FUGITIVE AIR	POINT AIR	WATER DISCHARGES	UNDERGROUND INJECTION	LAND DISPOSAL	TOTAL RELEASES	AVG. RELEASE PER FACILITY
SULFURIC ACID	157	385,882	321,639	27,700	0	4,705	739,926	4,713
MANGANESE COMPOUNDS	110	472,855	808,182	145,595	4,800	21,252,405	22,683,837	206,217
CHROMIUM COMPOUNDS	108	19,821	87,971	53,107	4,800	1,953,629	2,119,328	19,623
ZINC COMPOUNDS	108	596,037	874,585	121,804	250	13,497,412	15,090,088	139,723
HYDROCHLORIC ACID	102	612,814	1,469,636	25	11,726,300	744	13,809,519	135,387
CHROMIUM	95	10,858	24,926	4,432	0	415,839	456,055	4,801
MANGANESE	94	38,655	42,782	79,069	0	791,189	951,695	10,124
NICKEL COMPOUNDS	86	9,030	12,107	11,007	1,100	654,514	687,758	7,997
NICKEL	83	10,505	19,817	9,490	3,200	126,359	169,371	2,041
NITRIC ACID	66	96,647	487,887	39	0	44,730	629,303	9,535
LEAD	61	34,634	107,468	17,088	0	126,479	285,669	4,683
LEAD COMPOUNDS	61	55,593	76,024	11,559	0	1,087,501	1,230,677	20,175
AMMONIA	59	5,162,886	1,012,664	4,836,185	860,000	6,479	11,878,214	201,326
PHOSPHORIC ACID	56	78,666	7,672	260	0	142,814	229,412	4,097
COPPER COMPOUNDS	51	10,474	81,731	8,918	1,100	1,518,033	1,620,256	31,770
COPPER	36	17,281	4,902	3,237	0	16,320	41,740	1,159
ZINC (FUME OR DUST)	36	328,089	322,975	58,831	0	3,571,000	4,280,895	118,914
XYLENE (MIXED ISOMERS)	32	172,712	76,091	510	0	274	249,587	7,800
HYDROGEN FLUORIDE	30	96,276	133,328	19	0	20,789	250,412	8,347
TOLUENE	30	222,938	408,507	513	0	328	632,286	21,076
NAPHTHALENE	26	98,890	35,809	1,830	15,000	300	151,829	5,840
BENZENE	24	482,755	347,643	911	7,000	600	838,909	34,955
CYANIDE COMPOUNDS	24	14,928	91,928	72,033	41,000	909	220,798	9,200
CHLORINE	23	16,510	6,409	48,910	0	0	71,829	3,123
ETHYLENE GLYCOL	21	52,505	255	99,306	0	6,950	159,016	7,572
ETHYLENE	20	196,170	771,732	0	0	0	967,902	48,395
BARIUM COMPOUNDS	19	847	1,260	12,523	0	140,857	155,487	8,184
1,1,1-TRICHLOROETHANE	19	1,184,793	160,942	0	0	0	1,345,735	70,828
ANTHRACENE	17	3,830	11,636	9	0	0	15,475	910
PHENOL	16	101,903	77,677	30,445	76,000	23,817	309,842	19,365
ALUMINUM (FUME OR DUST)	15	5,536	56,575	22,522	0	210,064	294,697	19,646
PROPYLENE	15	28,149	81,649	0	0	0	109,798	7,320
METHANOL	14	487,709	18	0	0	35	487,762	34,840
DIBENZOFURAN	13	2,571	29	0	0	0	2,600	200
MOLYBDENUM TRIOXIDE	13	923	852	1,860	0	6,450	10,085	776
ETHYLBENZENE	12	13,504	3,803	250	0	0	17,557	1,463
TRICHLOROETHYLENE	12	572,277	484,600	5	0	0	1,056,882	88,074
AMMONIUM SULFATE(SOLUTION)	10	5	0	5,693	0	0	5,698	570
CADMIUM COMPOUNDS	10	904	1,391	5	0	0	2,300	230
STYRENE	10	4,724	636	5	0	7	5,372	537
COBALT	9	419	684	3,709	0	760	5,572	619
GLYCOL ETHERS	8	76,065	268,798	0	0	0	344,863	43,108
DICHLOROMETHANE	7	133,725	264,215	0	0	0	397,940	56,849
COBALT COMPOUNDS	6	18	781	535	0	3,100	4,434	739
CRESOL (MIXED ISOMERS)	6	6,341	1,801	259	0	0	8,401	1,400
QUINOLINE	6	379	1,801	5	0	0	2,185	364

Exhibit 7 (cont.): Releases for Iron and Steel Facilities (SIC 331) in TRI, by Number of Facilities Reporting (1993 Releases reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	FUGITIVE AIR	POINT AIR	WATER DISCHARGES	UNDERGROUND INJECTION	LAND DISPOSAL	TOTAL RELEASES	AVG. RELEASE PER FACILITY
QUINOLINE	6	2,185	379	1,801	5	0	2,185	364
1,2,4-TRIMETHYLBENZENE	6	9,730	434	0	0	0	10,164	1,694
ANTIMONY COMPOUNDS	5	1,715	110	635	0	1,052	3,512	702
BIPHENYL	5	202	1	0	0	0	203	41
ANTIMONY	4	803	650	5,515	0	1,300	8,260	2,067
TETRACHLOROETHYLENE	4	34,498	10,800	0	0	0	45,290	11,325
ACETONE	3	340,285	0	0	0	0	340,285	113,428
BARIUM	3	373	996	4,416	0	117,264	123,049	41,016
CADMIUM	3	24	388	0	0	0	412	137
SEC-BUTYL ALCOHOL	3	56,794	10,650	250	0	0	67,694	22,565
VANADIUM (FUME OR DUST)	3	4,180	700	3,200	0	22,000	30,080	10,027
CALCIUM CYANAMIDE	2	0	0	0	0	0	0	0
CARBON DISULFIDE	2	1,638	250	0	0	0	1,888	944
DIETHANOLAMINE	2	1,900	0	25,000	0	0	26,900	13,450
HYDROGEN CYANIDE	2	5	10	0	0	0	15	8
METHYL ETHYLKETONE	2	3,700	51,400	0	0	0	55,100	27,550
N-BUTYL ALCOHOL	2	250	27,807	0	0	0	28,057	14,029
SILVER	2	5	0	0	0	0	5	3
THIOUREA	2	250	0	767	0	0	1,017	509
ALUMINUM OXIDE(FIBROUS	1	250	0	0	0	0	250	250
ARSENIC	1	15	15	0	0	0	30	30
BROMOTRIFLUOROMETHANE	1	250	0	0	0	0	250	250
BUTYL BENZYL PHTHALATE	1	0	0	0	0	0	0	0
CARBONYL SULFIDE	1	250	0	0	0	0	250	250
METHYL ISOBUTYL KETONE	1	170	0	0	0	0	170	170
POLYCHLORINATED BIPHENYLS	1	0	0	0	0	0	0	0
PYRIDINE	1	750	16,000	0	8,200	0	24,950	24,950
SELENIUM COMPOUNDS	1	0	0	0	0	0	0	0
1,3-BUTADIENE	1	250	0	0	0	0	250	250
2,4-DIMETHYLPHENOL	1	250	0	0	0	0	250	250
TOTAL	381	12,377,570	9,174,029	5,729,986	12,748,750	45,767,008	85,797,343	85,797,343

Exhibit 8: Transfers for Iron and Steel Facilities in TRI, by Number of Facilities Reporting (1993 Transfers reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	POTW DISCHARGES	DISPOSAL	RECYCLING	TREATMENT	ENERGY RECOVERY	TOTAL TRANSFERS	AVG. TRANSFER PER FACILITY
SULFURIC ACID	157	7,192,127	11,060,393	15,416,092	6,533,083	0	40,295,552	256,660
MANGANESE COMPOUNDS	110	1,498	2,500,170	25,091,810	514,579	0	28,108,057	255,528
CHROMIUM COMPOUNDS	108	1,353	1,394,134	25,225,915	312,628	1,059	26,935,089	249,399
ZINC COMPOUNDS	108	8,611	34,813,453	157,386,808	5,021,396	3,100	197,233,368	1,826,235
HYDROCHLORIC ACID	102	217,138	395,161	32,888,151	23,981,197	8,497,000	65,978,647	646,849
CHROMIUM	95	2,289	1,010,326	32,865,366	36,816	750	33,915,547	357,006
MANGANESE	94	2,461	4,442,385	39,076,967	40,744	0	43,562,557	463,431
NICKEL COMPOUNDS	86	4,678	381,519	8,831,918	121,984	0	9,340,099	108,606
NICKEL	83	2,091	455,271	13,271,504	57,207	0	13,786,073	166,097
NITRIC ACID	66	51,087	1,616,149	54,046	3,073,168	0	4,794,450	72,643
LEAD	61	2,242	515,410	7,382,111	151,145	27	8,050,935	131,983
LEAD COMPOUNDS	61	957	682,835	13,703,747	152,866	0	14,540,405	238,367
AMMONIA	59	488,144	53,077	0	5,650	2,700	549,821	9,319
PHOSPHORIC ACID	56	9	90,626	18,000	19,549	0	128,184	2,289
COPPER COMPOUNDS	51	1,930	99,140	998,167	35,473	0	1,134,710	22,249
COPPER	36	746	63,934	5,598,545	7,123	0	5,670,348	157,510
ZINC (FUME OR DUST)	36	958	669,220	60,234,732	199,821	0	61,104,731	1,697,354
XYLENE(MIXED ISOMERS)	32	308	600	7,360	828	23,816	32,912	1,029
HYDROGEN FLUORIDE	30	28,300	387,574	15,046	827,889	0	1,258,809	41,960
TOLUENE	30	360	650	1,760	7,747	7,897	18,414	614
NAPHTHALENE	26	1,578	24,300	0	3,561	900	30,339	1,167
BENZENE	24	1,574	1,800	469	4,477	1,800	10,120	422
CYANIDE COMPOUNDS	24	29,753	3,184	0	13,238	0	46,175	1,924
CHLORINE	23	1,310	250	92,563	0	0	94,123	4,092
ETHYLENE GLYCOL	21	250	16,984	279,247	25,000	57,550	379,031	18,049
ETHYLENE	20	0	0	0	0	0	0	0
BARIUM COMPOUNDS	19	0	132,219	68,028	0	0	200,247	10,539
1,1,1-TRICHLOROETHANE	19	0	2,000	165,861	33,988	79,528	281,377	14,809
ANTHRACENE	17	0	4,200	0	2	0	4,202	247
PHENOL	16	359,945	1,176	0	108,247	6,464	475,832	29,740
ALUMINUM(FUME OR DUST)	15	5	125,775	47,675,040	0	0	47,800,820	3,186,721
PROPYLENE	15	0	0	0	0	0	0	0
METHANOL	14	720	0	0	0	0	720	51
DIBENZOFURAN	13	0	2,690	0	0	0	2,690	207
MOLYBDENUM TRIOXIDE	13	0	750	139,341	0	0	140,091	10,776
ETHYLBENZENE	12	0	325	760	250	1,502	2,837	236
TRICHLOROETHYLENE	12	0	38,556	76,036	53,726	24,191	192,509	16,042
AMMONIUM	10	0	2,000,000	0	0	0	2,000,000	200,000
CADMIUM COMPOUNDS	10	0	0	194,474	1,369	0	195,843	19,584
STYRENE	10	5	322	0	0	0	327	33
COBALT	9	0	40,026	830,040	7	0	870,073	96,675
GLYCOL ETHERS	8	0	0	0	1,273	26,000	27,273	3,409
DICHLOROMETHANE	7	0	0	8,229	8,200	750	17,179	2,454
COBALT COMPOUNDS	6	255	444	75,378	1,355	0	77,432	12,905
CRESOL(MIXED ISOMERS)	6	5	5	0	501	2,107	2,618	436
QUINOLINE	6	5	510	0	0	0	515	86

Exhibit 8 (cont.): Transfers for Iron and Steel Facilities in TRI, by Number of Facilities Reporting
(1993 Transfers reported in pounds/year)

CHEMICAL NAME	# REPORTING CHEMICAL	POTW DISCHARGES	DISPOSAL	RECYCLING	TREATMENT	ENERGY RECOVERY	TOTAL TRANSFERS	AVG. TRANSFER PER FACILITY
QUINOLINE	6	5	510	0	0	0	515	86
1,2,4-TRIMETHYLBENZENE	6	0	380	0	250	750	1,380	230
ANTIMONY COMPOUNDS	5	0	410	0	0	0	410	82
BIPHENYL	5	0	550	0	0	0	550	110
ANTIMONY	4	0	34,855	0	0	0	34,855	8,714
TETRACHLOROETHYLENE	4	0	4,000	13,853	0	3,517	21,370	5,343
ACETONE	3	0	1	0	4,308	0	4,309	1,436
BARIUM	3	0	5	3,105	0	0	3,110	1,037
CADMIUM	3	0	17,400	82,944	0	0	100,344	33,448
SEC-BUTYL ALCOHOL	3	0	0	0	990	0	990	330
VANADIUM (FUME OR DUST)	3	0	0	0	0	0	0	0
CALCIUM CYANAMIDE	0	0	0	0	0	0	0	0
CARBON DISULFIDE	0	0	0	0	0	0	0	0
DIETHANOLAMINE	0	0	0	0	0	0	0	0
HYDROGEN CYANIDE	0	0	0	0	0	0	0	0
METHYL ETHYL KETONE	2	0	0	0	0	339	0	170
N-BUTYL ALCOHOL	2	0	0	0	0	500	2	250
SILVER	2	5	0	2,666	0	0	2	1,336
THIOUREA	0	0	0	0	0	0	2	0
ALUMINUM OXIDE(FIBROUS	1	0	0	0	52,117	0	1	52,117
ARSENIC	0	0	0	0	0	0	1	0
BROMOTRIFLUOROMETHANE	0	0	0	0	0	0	1	0
BUTYL BENZYL PHTHALATE	0	0	0	0	0	0	1	0
CARBONYL SULFIDE	0	0	0	0	0	0	1	0
METHYL ISOBUTYL KETONE	0	0	0	0	0	0	1	0
POLYCHLORINATED BIPHENYLS	1	0	18,691	0	6,428	0	1	25,119
PYRIDINE	0	0	0	0	0	0	1	0
SELENIUM COMPOUNDS	1	0	736	0	0	0	1	736
1,3-BUTADIENE	0	0	0	0	0	0	1	0
2,4-DIMETHYLPHENOL	0	0	0	0	0	0	1	0
TOTAL	381	8,402,697	63,104,571	487,776,079	41,420,180	8,742,247	609,539,881	1,599,842

The TRI database contains a detailed compilation of self-reported, facility-specific chemical releases. The top reporting facilities for this sector based on pounds released are listed below. Facilities that have reported only the SIC codes covered under this notebook appear on the first list. The second list contains additional facilities that have reported the SIC code covered within this report, and one or more SIC codes that are not within the scope of this notebook. Therefore, the second list includes facilities that conduct multiple operations - some that are under the scope of this notebook, and some that are not. Currently, the facility-level data do not allow pollutant releases to be broken apart by industrial process.

Exhibit 9: Top 10 TRI Releasing Iron and Steel Facilities[a]

Rank	Facility	Total TRI Releases in Pounds
1	Elkem Metals Co* - Marietta, OH	18,604,572
2	Northwestern Steel & Wire Co. - Sterling, IL	14,274,570
3	Granite City Steel - Granite City, IL	5,156,148
4	Midwest Steel Div. Midwest Steel Div. - Portage, IN	4,735,000
5	AK Steel Corp. Middletown Works - Middletown, OH	4,189,050
6	Bethlehem Steel Corp. Burns Harbor Div. - Burns Harbor, IN	3,899,470
7	Wheeling-Pittsburgh Steel Corp Mingo Junction Plant - Mingo Junction, OH	3,089,795
8	USS Gary Works - Gary, IN	2,403,348
9	LTV Steel Co. Inc. Cleveland Works - Cleveland, OH	1,985,131
10	Gulf States Steel Inc. - Gadsden, AL	1,959,707

Source: U.S. EPA *Toxic Release Inventory Database*, 1993.
* This is an Electrometallurgical Products facility (SIC 3313), not a steel mill.

[a] Being included on this list does not mean that the release is associated with non-compliance with environmental laws.

Exhibit 10: Top 10 TRI Releasing Facilities Reporting SIC 331 Operations[b]			
Rank	**SIC Codes Reported in TRI**	**Facility**	**Total TRI Releases in Pounds**
1	3313	Elkem Metals Co* - Marietta, OH	18,604,572
2	3312, 3315	Northwestern Steel & Wire Co. - Sterling, IL	14,274,570
3	3312, 3274	Inland Steel Co. - East Chicago, IN	10,618,719
4	3313, 2819	Kerr-McGee Chemical Corp. Electrolytic Plant - Hamilton, MS*	5,446,555
5	3312	Granite City Steel - Granite City, IL	5,156,148
6	3316	Midwest Steel Div. Midwest Steel Div. - Portage, IN	4,735,000
7	3312	AK Steel Corp. Middletown Works - Middletown, OH	4,189,050
8	3312	Bethlehem Steel Corp. Burns Harbor Div. - Burns Harbor, IN	3,899,470
9	3312	Wheeling-Pittsburgh Steel Corp Mingo Junction Plant - Mingo Junction, OH	3,089,795
10	3312	USS Gary Works - Gary, IN	2,403,348

Source: U.S. EPA *Toxic Release Inventory Database*, 1993.
* This is an Electrometallurgical Products facility (SIC 3313), not a steel mill.

IV.B. Summary of Selected Chemicals Released

The following is a synopsis of current scientific toxicity and fate information for the top chemicals (by weight) that facilities within this sector self-reported as released to the environment based upon 1993 TRI data. Because this section is based upon self-reported release data, it does not attempt to provide information on management practices employed by the sector to reduce the release of these chemicals. Information regarding pollutant release reduction over time may be available from EPA's TRI and 33/50 programs, or directly from the industrial trade associations that are listed in Section IX of this document. Since these descriptions are cursory, please consult the sources referenced below for a more detailed description of both the chemicals described in this section, and the chemicals that appear on the full list of TRI chemicals appearing in Section IV.A.

[b] Being included on this list does not mean that the release is associated with non-compliance with environmental laws.

The brief descriptions provided below were taken from the *1993 Toxics Release Inventory Public Data Release* (EPA, 1994), and the Hazardous Substances Data Bank (HSDB), accessed via TOXNET. TOXNET is a computer system run by the National Library of Medicine. It includes a number of toxicological databases managed by EPA, the National Cancer Institute, and the National Institute for Occupational Safety and Health.[c] HSDB contains chemical-specific information on manufacturing and use, chemical and physical properties, safety and handling, toxicity and biomedical effects, pharmacology, environmental fate and exposure potential, exposure standards and regulations, monitoring and analysis methods, and additional references. The information contained below is based upon exposure assumptions that have been conducted using standard scientific procedures. The effects listed below must be taken in context of these exposure assumptions that are more fully explained within the full chemical profiles in HSDB. For more information on TOXNET, contact the TOXNET help line at 1-800-231-3766.

Ammonia (CAS: 7664-41-7)

Sources. In cokemaking, ammonia is produced by the decomposition of the nitrogen-containing compounds which takes place during the secondary thermal reaction (at temperatures greater than 700°C (1296°F)). The ammonia formed during coking exists in both the water and gas that form part of the volatile products. The recovery of this ammonia can be accomplished by several different processes where the by-product ammonium sulfate is formed by the reaction between the ammonia and sulfuric acid.[23]

Toxicity. Anhydrous ammonia is irritating to the skin, eyes, nose, throat, and upper respiratory system.

Ecologically, ammonia is a source of nitrogen (an essential element for aquatic plant growth), and may therefore contribute to eutrophication of standing or slow-moving surface water, particularly in nitrogen-limited waters such as the Chesapeake Bay. In addition, aqueous ammonia is moderately toxic to aquatic organisms.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

[c] Databases included in TOXNET are: CCRIS (Chemical Carcinogenesis Research Information System), DART (Developmental and Reproductive Toxicity Database), DBIR (Directory of Biotechnology Information Resources), EMICBACK (Environmental Mutagen Information Center Backfile), GENE-TOX (Genetic Toxicology), HSDB (Hazardous Substances Data Bank), IRIS (Integrated Risk Information System), RTECS (Registry of Toxic Effects of Chemical Substances), and TRI (Toxic Chemical Release Inventory).

Environmental Fate. Ammonia combines with sulfate ions in the atmosphere and is washed out by rainfall, resulting in rapid return of ammonia to the soil and surface waters.

Ammonia is a central compound in the environmental cycling of nitrogen. Ammonia in lakes, rivers, and streams is converted to nitrate.

Physical Properties. Ammonia is a corrosive and severely irritating gas with a pungent odor.

Hydrochloric Acid (CAS: 7647-01-1)

Sources. During hot rolling, a hard black iron oxide is formed on the surface of the steel. This "scale" is removed chemically in the pickling process which commonly uses hydrochloric acid.[24]

Toxicity. Hydrochloric acid is primarily a concern in its aerosol form. Acid aerosols have been implicated in causing and exacerbating a variety of respiratory ailments. Dermal exposure and ingestion of highly concentrated hydrochloric acid can result in corrosivity.

Ecologically, accidental releases of solution forms of hydrochloric acid may adversely affect aquatic life by including a transient lowering of the pH (i.e., increasing the acidity) of surface waters.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Releases of hydrochloric acid to surface waters and soils will be neutralized to an extent due to the buffering capacities of both systems. The extent of these reactions will depend on the characteristics of the specific environment.

Physical Properties. Concentrated hydrochloric acid is highly corrosive.

Manganese and Manganese Compounds (CAS: 7439-96-5; 20-12-2)

Sources. Manganese is found in the iron charge and is used as an addition agent added to alloy steel to obtain desired properties in the final product. In carbon steel, manganese is used to combine with sulfur to improve the ductility of the steel. An alloy steel with manganese is used for applications involving relatively small sections which are subject to severe service conditions, or in larger sections where the weight saving derived from the higher strength of the alloy steels is needed.[25]

Toxicity. There is currently no evidence that human exposure to manganese at levels commonly observed in ambient atmosphere results in adverse health effects. However, recent EPA review of the fuel additive MMT (methylcyclopentadienyl manganese tricarbonyl) concluded that use of MMT in gasoline could lead to ambient exposures to manganese at a level sufficient to cause adverse neurological effects in humans.

Chronic manganese poisoning bears some similarity to chronic lead poisoning. Occurring via inhalation of manganese dust or fumes, it primarily involves the central nervous system. Early symptoms include languor, speech disturbances, sleepiness, and cramping and weakness in legs. A stolid mask-like appearance of face, emotional disturbances such as absolute detachment broken by uncontrollable laughter, euphoria, and a spastic gait with a tendency to fall while walking are seen in more advanced cases. Chronic manganese poisoning is reversible if treated early and exposure stopped. Populations at greatest risk of manganese toxicity are the very young and those with iron deficiencies.

Ecologically, although manganese is an essential nutrient for both plants and animals, in excessive concentrations manganese inhibits plant growth.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Manganese is an essential nutrient for plants and animals. As such, manganese accumulates in the top layers of soil or surface water sediments and cycles between the soil and living organisms. It occurs mainly as a solid under environmental conditions, though may also be transported in the atmosphere as a vapor or dust.

1,1,1-Trichloroethane (CAS: 71-55-6)

Sources. Used for surface cleaning of steel prior to coating.

Toxicity. Repeated contact of 1,1,1-trichloroethane (TCE) with skin may cause serious skin cracking and infection. Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations.

Exposure to high concentrations of TCE causes reversible mild liver and kidney dysfunction, central nervous system depression, gait disturbances, stupor, coma, respiratory depression, and even death. Exposure to lower concentrations of TCE leads to light-headedness, throat irritation, headache, disequilibrium, impaired coordination, drowsiness, convulsions and mild changes in perception.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Releases of TCE to surface water or land will almost entirely volatilize. Releases to air may be transported long distances and may partially return to earth in rain. In the lower atmosphere, TCE degrades very slowly by photooxidation and slowly diffuses to the upper atmosphere where photodegradation is rapid.

Any TCE that does not evaporate from soils leaches to groundwater. Degradation in soils and water is slow. TCE does not hydrolyze in water, nor does it significantly bioconcentrate in aquatic organisms.

Zinc and Zinc Compounds (CAS: 7440-66-6; 20-19-9)

Sources. To protect steel from rusting, it is coated with a material that will protect it from moisture and air. In the galvanizing process, steel is coated with zinc.[26]

Toxicity. Zinc is a nutritional trace element; toxicity from ingestion is low. Severe exposure to zinc might give rise to gastritis with vomiting due to swallowing of zinc dusts. Short-term exposure to very high levels of zinc is linked to lethargy, dizziness, nausea, fever, diarrhea, and reversible pancreatic and neurological damage. Long-term zinc poisoning causes irritability, muscular stiffness and pain, loss of appetite, and nausea.

Zinc chloride fumes cause injury to mucous membranes and to the skin. Ingestion of soluble zinc salts may cause nausea, vomiting, and purging.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Significant zinc contamination of soil is only seen in the vicinity of industrial point sources. Zinc is a relatively stable soft metal, though burns in air. Zinc bioconcentrates in aquatic organisms.

IV.C. Other Data Sources

The toxic chemical release data obtained from TRI captures the vast majority of facilities in the iron and steel industry. It also allows for a comparison across years and industry sectors. Reported chemicals are limited however to the 316 reported chemicals. Most of the hydrocarbon emissions from iron and steel facilities are not captured by TRI.[27] The EPA Office of Air Quality Planning and Standards has compiled air pollutant emission factors for determining the total air emissions of priority pollutants (e.g., total hydrocarbons, SOx, NOx, CO, particulates, etc.) from many iron and steel manufacturing sources.[28]

The Aerometric Information Retrieval System (AIRS) contains a wide range of information related to stationary sources of air pollution, including the emissions of a number of air pollutants which may be of concern within a particular industry. With the exception of volatile organic compounds (VOCs), there is little overlap with the TRI chemicals reported above. Exhibit 11 summarizes annual releases (from the industries for which a Sector Notebook Profile was prepared) of carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter of 10 microns or less (PM10), total particulates (PT), sulfur dioxide (SO_2), and volatile organic compounds (VOCs). With 1.5 million short tons/year of carbon monoxide, the iron and steel industry emissions are estimated as more than twice as much as the next largest releasing industry, pulp and paper. Of the eighteen industries listed, the iron and steel industry also ranks as one of the top five releasers for NO_2, PM10, PT, and SO_2. Carbon monoxide releases occur during ironmaking (in the burning of coke, CO produced reduces iron oxide ore), and during steelmaking (in either the basic oxygen furnace or the electric arc furnace). Nitrogen dioxide is generated during steelmaking. Particulate matter may be emitted from the cokemaking (particularly in quenching operations), ironmaking, basic oxygen furnace (as oxides of iron that are emitted as sub-micron dust), or from the electric arc furnace (as metal dust containing iron particulate, zinc, and other materials associated with the scrap). Sulfur dioxide can be released in ironmaking or sintering.

Exhibit 11: Pollutant Releases (short tons/year)

Industry Sector	CO	NO_2	PM_{10}	PT	SO_2	VOC
U.S. Total	97,208,000	23,402,000	45,489,000	7,836,000	21,888,000	23,312,000
Metal Mining	5,391	28,583	39,359	140,052	84,222	1,283
Nonmetal Mining	4,525	28,804	59,305	167,948	24,129	1,736
Lumber and Wood Production	123,756	42,658	14,135	63,761	9,419	41,423
Furniture and Fixtures	2,069	2,981	2,165	3,178	1,606	59,426
Pulp and Paper	624,291	394,448	35,579	113,571	541,002	96,875
Printing	8,463	4,915	399	1,031	1,728	101,537
Inorganic Chemicals	166,147	103,575	4,107	39,062	182,189	52,091
Organic Chemicals	146,947	236,826	26,493	44,860	132,459	201,888
Petroleum Refining	419,311	380,641	18,787	36,877	648,155	369,058
Rubber and Misc. Plastics	2,090	11,914	2,407	5,355	29,364	140,741
Stone, Clay and Concrete	58,043	338,482	74,623	171,853	339,216	30,262
Iron and Steel	**1,518,642**	**138,985**	**42,368**	**83,017**	**238,268**	**82,292**
Nonferrous Metals	448,758	55,658	20,074	22,490	373,007	27,375
Fabricated Metals	3,851	16,424	1,185	3,136	4,019	102,186
Computer and Office Equipment	24	0	0	0	0	0
Electronics and Other Electrical Equipment and Components	367	1,129	207	293	453	4,854
Motor Vehicles, Bodies, Parts and Accessories	35,303	23,725	2,406	12,853	25,462	101,275
Dry Cleaning	101	179	3	28	152	7,310

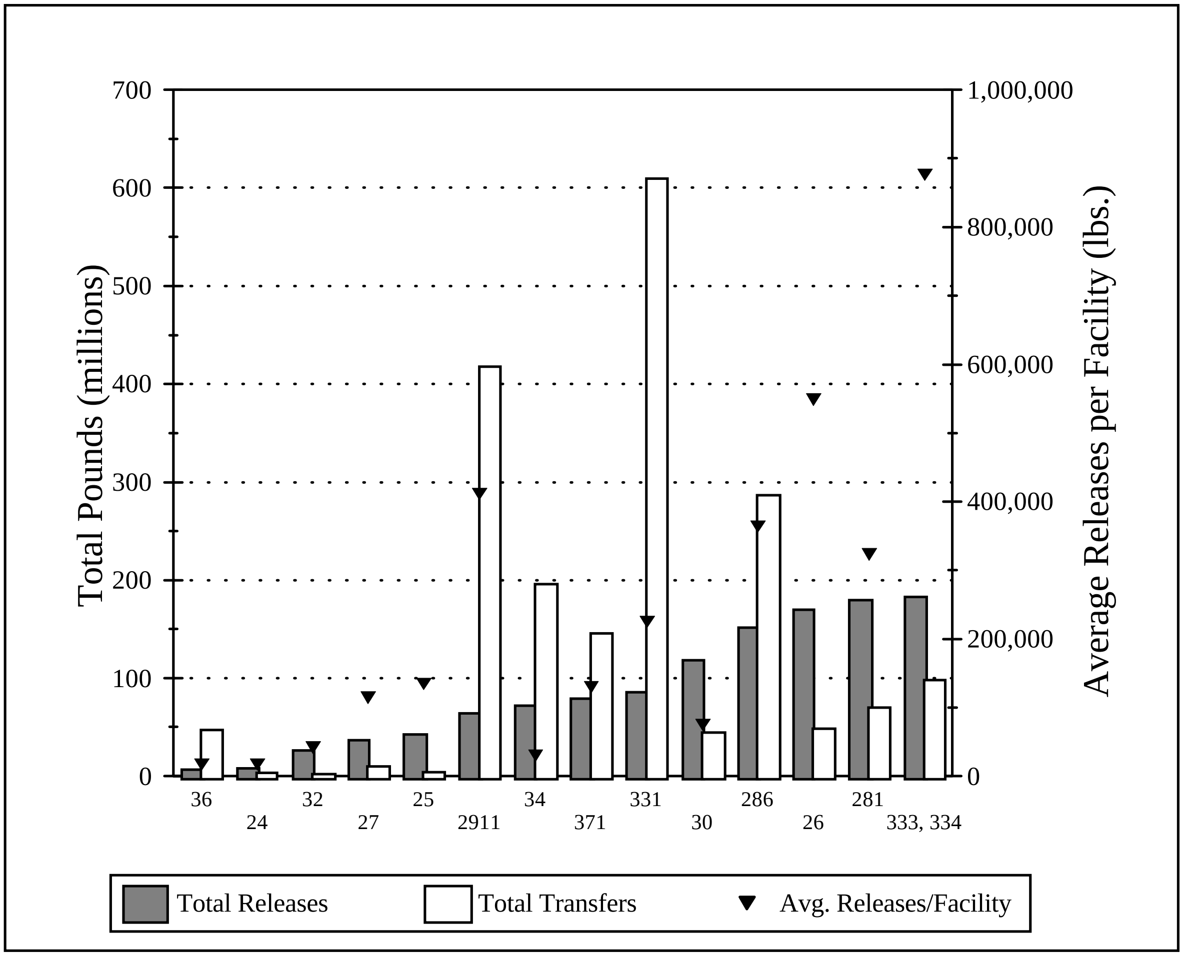
Source: U.S. EPA Office of Air and Radiation, AIRS Database, May 1995.

IV.D. Comparison of Toxic Release Inventory Between Selected Industries

The following information is presented as a comparison of pollutant release and transfer data across industrial categories. It is provided to give a general sense as to the relative scale of releases and transfers within each sector profiled under this project. Please note that the following figure and table do not contain releases and transfers for industrial categories that are not included in this project, and thus cannot be used to draw conclusions regarding the total release and transfer amounts that are reported to TRI. Similar information is available within the annual TRI Public Data Release Book.

Exhibit 12 is a graphical representation of a summary of the 1993 TRI data for the iron and steel industry and the other sectors profiled in separate notebooks. The bar graph presents the total TRI releases and total transfers on the left axis and the triangular points show the average releases per facility on the right axis. Industry sectors are presented in the order of increasing total TRI releases. The graph is based on the data shown in Exhibit 13 and is meant to facilitate comparisons between the relative amounts of releases, transfers, and releases per facility both within and between these sectors. The reader should note, however, that differences in the proportion of facilities captured by TRI exist between industry sectors. This can be a factor of poor SIC matching and relative differences in the number of facilities reporting to TRI from the various sectors. In the case of the iron and steel industry, the 1993 TRI data presented here covers 381 facilities. These facilities listed SIC 331 (Steel Works, Blast Furnaces, and Rolling and Finishing Mills) as a primary SIC code.

Exhibit 12: Summary of 1993 TRI Data: Releases and Transfers by Industry



SIC Range	Industry Sector	SIC Range	Industry Sector	SIC Range	Industry Sector
36	Electronic Equipment and Components	2911	Petroleum Refining	286	Organic Chemical Mfg.
24	Lumber and Wood Products	34	Fabricated Metals	26	Pulp and Paper
32	Stone, Clay, and Concrete	371	Motor Vehicles, Bodies, Parts, and Accessories	281	Inorganic Chemical Mfg.
27	Printing	331	Iron and Steel	333,334	Nonferrous Metals
25	Wood Furniture and Fixtures	30	Rubber and Misc. Plastics		

Exhibit 13: Toxics Release Inventory Data for Selected Industries

Industry Sector	SIC Range	# TRI Facilities	1993 TRI Releases: Total Releases (million lbs.)	1993 TRI Releases: Average Releases per Facility (pounds)	1993 TRI Transfers: Total Transfers (million lbs.)	1993 TRI Transfers: Average Transfers per Facility (pounds)	Total Releases + Transfers (million lbs.)	Average Releases+ Transfers per Facility (pounds)
Stone, Clay, and Concrete	32	634	26.6	42,000	2.2	4,000	28.8	46,000
Lumber and Wood Products	24	491	8.4	17,000	3.5	7,000	11.9	24,000
Furniture and Fixtures	25	313	42.2	135,000	4.2	13,000	46.4	148,000
Printing	2711-2789	318	36.5	115,000	10.2	32,000	46.7	147,000
Electronic Equip. and Components	36	406	6.7	17,000	47.1	116,000	53.7	133,000
Rubber and Misc. Plastics	30	1,579	118.4	75,000	45	29,000	163.4	104,000
Motor Vehicles, Bodies, Parts, and Accessories	371	609	79.3	130,000	145.5	239,000	224.8	369,000
Pulp and Paper	2611-2631	309	169.7	549,000	48.4	157,000	218.1	706,000
Inorganic Chem. Mfg.	2812-2819	555	179.6	324,000	70	126,000	249.7	450,000
Petroleum Refining	2911	156	64.3	412,000	417.5	2,676,000	481.9	3,088,000
Fabricated Metals	34	2,363	72	30,000	195.7	83,000	267.7	123,000
Iron and Steel	**331**	**381**	**85.8**	**225,000**	**609.5**	**1,600,000**	**695.3**	**1,825,000**
Nonferrous Metals	333, 334	208	182.5	877,000	98.2	472,000	280.7	1,349,000
Organic Chemical Mfg.	2861-2869	417	151.6	364,000	286.7	688,000	438.4	1,052,000
Metal Mining	10	Industry sector not subject to TRI reporting.						
Nonmetal Mining	14	Industry sector not subject to TRI reporting.						
Dry Cleaning	7216	Industry sector not subject to TRI reporting.						

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

V. POLLUTION PREVENTION OPPORTUNITIES

The best way to reduce pollution is to prevent it in the first place. Some companies have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts. This can be done in many ways such as reducing material inputs, re-engineering processes to reuse by-products, improving management practices, and employing substitution of toxic chemicals. Some smaller facilities are able to actually get below regulatory thresholds just by reducing pollutant releases through aggressive pollution prevention policies.

In order to encourage these approaches, this section provides both general and company-specific descriptions of some pollution prevention advances that have been implemented within the iron and steel industry. While the list is not exhaustive, it does provide core information that can be used as the starting point for facilities interested in beginning their own pollution prevention projects. This section provides summary information from activities that may be, or are being implemented by this sector. When possible, information is provided that gives the context in which the technique can be effectively used. Please note that the activities described in this section do not necessarily apply to all facilities that fall within this sector. Facility-specific conditions must be carefully considered when pollution prevention options are evaluated, and the full impacts of the change must examine how each option affects air, land and water pollutant releases.

Most of the pollution prevention activities in the iron and steel industry have concentrated on reducing cokemaking emissions, Electric Arc Furnace (EAF) dust, and spent acids used in finishing operations. Due to the complexity, size, and age of the equipment used in steel manufacturing, projects that have the highest pollution prevention potential often require significant capital investments. This section describes pollution prevention opportunities for each of the three focus areas (cokemaking, EAF dust, and finishing acids), and then lists some general pollution prevention opportunities that have been identified by the iron and steel industry.

Cokemaking

The cokemaking process is seen by industry experts as one of the steel industry's areas of greatest environmental concern, with coke oven air emissions and quenching waste water as the major problems. In response to expanding regulatory constraints, including the Clean Air Act National Emission Standards for coke ovens completed in 1993, U.S. steelmakers are turning to new technologies to decrease the sources of pollution from, and their reliance on, coke. Pollution prevention in cokemaking has focused on two areas: reducing coke oven emissions and developing cokeless ironmaking techniques. Although these processes have not yet been widely demonstrated on a commercial scale, they may provide significant benefits for the integrated segment of the industry in the form of substantially lower air emissions and wastewater discharges than current operations.

Eliminating Coke with Cokeless Technologies

Cokeless technologies substitute coal for coke in the blast furnace, eliminating the need for cokemaking. Such technologies have enormous potential to reduce pollution generated during the steelmaking process. The capital investment required is also significant. Some of the cokeless technologies in use or under development include:

• *The Japanese Direct Iron Ore Smelting (DIOS) process.* This process produces molten iron directly with coal and sinter feed ore. A 500 ton per day pilot plant was started up in October, 1993 and the designed production rates were attained as a short term average. During 1995, the data generated will be used to determine economic feasibility on a commercial scale.

• *HIsmelt process.* A plant using the HIsmelt process for molten iron production, developed by HIsmelt Corporation of Australia, was started up in late 1993. The process, using ore fines and coal, has achieved a production rate of 8 tons per hour using ore directly in the smelter. Developers anticipate reaching the production goal of 14 tons per hour. During 1995, the data generated will be used to determine economic feasibility on commercial scale. If commercial feasibility is realized, Midrex is expected to become the U.S. engineering licensee of the HIsmelt process.

• *Corex process.* The Corex or Cipcor process has integral coal desulfurizing, is amenable to a variety of coal types, and generates electrical power in excess of that required by an iron and steel mill which can be sold to local power grids. A Corex plant is in operation in South Africa, and other plants are expected to be operational in the next two years in South Korea and India.

Reducing Coke Oven Emissions

Several technologies are available or are under development to reduce the emissions from coke ovens. Typically, these technologies reduce the quantity of coke needed by changing the method by which coke is added to the blast furnace or by substituting a portion of the coke with other fuels. The reduction in the amount of coke produced proportionally reduces the coking emissions. Some of the most prevalent or promising coke reduction technologies include:

• *Pulverized coal injection.* This technology substitutes pulverized coal for a portion of the coke in the blast furnace. Use of pulverized coal injection can replace about 25 to 40 percent of coke in the blast furnace, substantially reducing emissions associated with cokemaking operations. This reduction ultimately depends on the fuel injection rate applied to the blast furnaces which will, in turn be dictated by the aging of existing coking facilities, fuel costs, oxygen availability, capital requirements for fuel injection, and available hot blast temperature.

• *Non-recovery coke battery*. As opposed to the by-product recovery coke plant, the non-recovery coke battery is designed to allow combustion of the gasses from the coking process, thus consuming the by-products that are typically recovered. The process results in lower air emissions and substantial reductions in coking process wastewater discharges.

• *The Davy Still Autoprocess.* In this pre-combustion cleaning process for coke ovens, coke oven battery process water is utilized to strip ammonia and hydrogen sulfide from coke oven emissions.

• *Alternative fuels.* Steel producers can also inject other fuels, such as natural gas, oil, and tar/pitch, instead of coke into the blast furnace, but these fuels can only replace coke in limited amounts.

Recycling of Coke By-products

Improvements in the in-process recycling of tar decanter sludge, a RCRA listed hazardous waste (K087) are common practice. Sludge can either be injected into the ovens to contribute to coke yield, or converted into a fuel that is suitable for the blast furnace.

Reducing Wastewater Volume

In addition to air emissions, quench water from cokemaking is also an area of significant environmental concern. In Europe, some plants have implemented technology to shift from water quenching to dry quenching in order to reduce energy costs. However, major construction changes are required for such a solution and considering the high capital costs of coke batteries, the depressed state of the steel industry, and increased regulations for cokemaking, it is unlikely that this pollution prevention opportunity will be widely adopted in the U.S.

Electric Arc Furnace Dust

Dust generation in the EAF, and its disposal, have also been recognized as a serious problem, but one with potential for pollution prevention through material recovery. EAF dust is a RCRA listed waste (K061) because of its high concentrations of lead and cadmium. With 550,000 tons of EAF dust generated annually in the U.S., there is great potential to reduce the volume of this hazardous waste.[27] Steel companies typically pay a disposal fee of $150 to $200 per ton of dust. With an average zinc concentration of 19 percent, much of the EAF dust is shipped off-site for zinc reclamation. Most of the EAF dust recovery options are only economically viable for dust with a zinc content of at least 15 - 20 percent. Facilities producing specialty steels such as stainless steel with a lower zinc content, still have opportunities to recover chromium and nickel from the EAF dust.

In-process recycling of EAF dust involves pelletizing and then reusing the pellets in the furnace, however, recycling of EAF dust on-site has not proven to be technically or economically competitive for all mills. Improvements in technologies have made off-site recovery a cost effective alternative to thermal treatment or secure landfill disposal.

Pickling Acids

In finishing, pickling acids are recognized as an area where pollution prevention efforts can have a significant impact in reducing the environmental impact of the steel mill. The pickling process removes scale and cleans the surface of raw steel by dipping it into a tank of hydrochloric or sulfuric acid. If not recovered, the spent acid may be transported to deep injection wells for disposal, but as those wells continue to close, alternative disposal costs are rising.

Large-scale steel manufacturers commonly recover hydrochloric acid in their finishing operations, however the techniques used are not suitable for small- to medium-sized steel plants.[28] Currently, a recovery technique for smaller steel manufacturers and galvanizing plants is in pilot scale testing. The system under development removes iron chloride (a saleable product) from the hydrochloric acid, reconcentrates the acid for reuse, and recondenses the water to be reused as a rinse water in the pickling process. Because the only by-product of the hydrochloric acid recovery process is a non-hazardous, marketable metal chloride, this technology generates no hazardous wastes. The manufacturer projects industry-wide hydrochloric acid waste reduction of 42,000 tons/year by 2010. This technology is less expensive than transporting and disposing waste acid, plus it eliminates the associated long-term liability. The total savings for a small- to medium-sized galvanizer is projected to be $260,000 each year.

The pilot scale testing project is funded in part by a grant from the U.S. Department of Energy under the NICE[3] program (see section VIII.B. for program information) and the EPA. (Contact: Bill Ives, DOE, 303-275-4755)

To reduce spent pickling liquor (K062) and simultaneously reduce fluoride in the plant effluent, one facility modified their existing treatment process to recover the fluoride ion from rinse water and spent pickling acid raw water waste streams. The fluoride is recovered as calcium fluoride (fluorspar), an input product for steelmaking. The melt shop in the same plant had been purchasing 930 tons of fluorspar annually for use as a furnace flux material in the EAF at a cost of $100 per ton. Although the process is still under development, the recovered calcium fluoride is expected to be a better grade than the purchased fluorspar, which would reduce the amount of flux used by approximately 10 percent. Not only would the generation rate of sludge from spent pickling liquor treatment be reduced (resulting in a savings in off-site sludge disposal costs), but a savings in chemical purchases would be realized.

Other areas with pollution prevention opportunities
Other areas in iron and steel manufacturing where opportunities may exist for pollution prevention are listed below, in three categories: process modifications, materials substitution, and recycling.

Process Modification

Redesigning or modifying process equipment can reduce pollution output, maintenance costs, and energy consumption, for example:

• Replacing single-pass wastewater systems with closed-loop systems to minimize chemical use in wastewater treatment and to reduce water use.
• Continuous casting, now used for about 90% of crude steel cast in the U.S., offers great improvements in process efficiency when compared to the traditional ingot teeming method. This increased efficiency also results in a considerable savings in energy and some reduction in the volume of mill wastewater.

Materials Substitution

• Use scrap steel with low lead and cadmium content as a raw material, if possible.
• Eliminate the generation of reactive desulfurization slag generated in foundry work by replacing calcium carbide with a less hazardous material.

Recycling

Scrap and other materials are recycled extensively in the iron and steel industry to reduce the raw materials required and the associated pollutants. Some of these recycling activities include:
• Recycle or reuse oils and greases.
• Recover acids by removing dissolved iron salts from spent acids.
• Use thermal decomposition for acid recovery from spent pickle liquor.
• Use a bipolar membrane/electrodialytic process to separate acid from metal by-products in spent NO_3-HF pickle liquor.
• Recover sulfuric acid using low temperature separation of acid and metal crystals.

VI. SUMMARY OF APPLICABLE FEDERAL STATUTES AND REGULATIONS

This section discusses the Federal regulations that may apply to this sector. The purpose of this section is to highlight and briefly describe the applicable Federal requirements, and to provide citations for more detailed information. The three following sections are included:

- Section VI.A. contains a general overview of major statutes
- Section VI.B. contains a list of regulations specific to this industry
- Section VI.C. contains a list of pending and proposed regulations

The descriptions within Section VI are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. For further information, readers should consult the Code of Federal Regulations and other state or local regulatory agencies. EPA Hotline contacts are also provided for each major statute.

VI.A. General Description of Major Statutes

Resource Conservation and Recovery Act

The Resource Conservation And Recovery Act (RCRA) of 1976 which amended the Solid Waste Disposal Act, addresses solid (Subtitle D) and hazardous (Subtitle C) waste management activities. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a "cradle-to-grave" system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (commercial chemical products, designated with the code "P" or "U"; hazardous wastes from specific industries/sources, designated with the code "K"; or hazardous wastes from non-specific sources, designated with the code "F") or materials which exhibit a hazardous waste characteristic (ignitability, corrosivity, reactivity, or toxicity and designated with the code "D").

Regulated entities that generate hazardous waste are subject to waste accumulation, manifesting, and record keeping standards. Facilities that treat, store, or dispose of hazardous waste must obtain a permit, either from EPA or from a State agency which EPA has authorized to implement the permitting program. Subtitle C permits contain general facility standards such as contingency plans, emergency procedures, record keeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Part 264 Subpart S and §264.10) for conducting corrective actions which govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA-regulated facilities.

Although RCRA is a Federal statute, many States implement the RCRA program. Currently, EPA has delegated its authority to implement various provisions of RCRA to 46 of the 50 States.

Most RCRA requirements are not industry specific but apply to any company that transports, treats, stores, or disposes of hazardous waste. Here are some important RCRA regulatory requirements:

- **Identification of Solid and Hazardous Wastes** (40 CFR Part 261) lays out the procedure every generator should follow to determine whether the material created is considered a hazardous waste, solid waste, or is exempted from regulation.

- **Standards for Generators of Hazardous Waste** (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an ID number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and record keeping and reporting requirements. Generators can accumulate hazardous waste for up to 90 days (or 180 days depending on the amount of waste generated) without obtaining a permit.

- **Land Disposal Restrictions** (LDRs) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs (40 CFR 268), materials must meet land disposal restriction (LDR) treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Wastes subject to the LDRs include solvents, electroplating wastes, heavy metals, and acids. Generators of waste subject to the LDRs must provide notification of such to the designated TSD facility to ensure proper treatment prior to disposal.

- **Used Oil Management Standards** (40 CFR Part 279) impose management requirements affecting the storage, transportation, burning, processing, and re-refining of the used oil. For parties that merely generate used oil, regulations establish storage standards. For a party considered a used oil marketer (one who generates and sells off-specification used oil directly to a used oil burner), additional tracking and paperwork requirements must be satisfied.

- **Tanks and Containers** used to store hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities who store such waste, including generators operating under the 90-day accumulation rule.

- **Underground Storage Tanks** (USTs) containing petroleum and hazardous substance are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also establishes increasingly stringent standards, including upgrade requirements for existing tanks, that must be met by 1998.

- **Boilers and Industrial Furnaces** (BIFs) that use or burn fuel containing hazardous waste must comply with design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and restrict the type of waste that may be burned.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, responds to questions and distributes guidance regarding all RCRA regulations. The RCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., ET, excluding Federal holidays.

Comprehensive Environmental Response, Compensation, And Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a 1980 law commonly known as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment. CERCLA also enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the Superfund for response costs incurred by EPA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for the Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

The CERCLA **hazardous substance release reporting regulations** (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance which exceeds a reportable quantity. Reportable quantities are defined and listed in 40 CFR §302.4. A release report may trigger a response by EPA, or by one or more Federal or State emergency response authorities.

EPA implements **hazardous substance responses** according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for permanent cleanups, known as remedial actions, and other cleanups referred to as "removals." EPA generally takes remedial actions only at sites on the National Priorities List (NPL), which currently includes approximately 1300 sites. Both EPA and states can act at other sites; however, EPA provides responsible parties the opportunity to conduct removal and remedial actions and encourages community involvement throughout the Superfund response process.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, answers questions and references guidance pertaining to the Superfund program. The CERCLA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., ET, excluding Federal holidays.

Emergency Planning And Community Right-To-Know Act

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created the Emergency Planning and Community Right-to-Know Act (EPCRA, also known as SARA Title III), a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by State and local governments. EPCRA required the establishment of State emergency response commissions (SERCs), responsible for coordinating certain emergency response activities and for appointing local emergency planning committees (LEPCs).

EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities which store or manage specified chemicals:

- **EPCRA §302** requires facilities to notify the SERC and LEPC of the presence of any "extremely hazardous substance" (the list of such substances is in 40 CFR Part 355, Appendices A and B) if it has such substance in excess of the substance's threshold planning quantity, and directs the facility to appoint an emergency response coordinator.

- **EPCRA §304** requires the facility to notify the SERC and the LEPC in the event of a release exceeding the reportable quantity of a CERCLA hazardous substance or an EPCRA extremely hazardous substance.

- **EPCRA §311 and §312** require a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold to submit to the SERC, LEPC and local fire department material safety data sheets (MSDSs) or lists of MSDS's and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.

- **EPCRA §313** requires manufacturing facilities included in SIC codes 20 through 39, which have ten or more employees, and which manufacture, process, or use specified chemicals in amounts greater than threshold quantities, to submit an annual toxic chemical release report. This report, commonly known as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media, and allows EPA to compile the national Toxic Release Inventory (TRI) database.

All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

EPA's EPCRA Hotline, at (800) 535-0202, answers questions and distributes guidance regarding the emergency planning and community right-to-know regulations. The EPCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., ET, excluding Federal holidays.

Clean Water Act

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA include "priority" pollutants, including various toxic pollutants; "conventional" pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; and "non-conventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and indirect discharges. The **National Pollutant Discharge Elimination System (NPDES)** program (CWA §402) controls direct discharges into navigable waters. Direct discharges or "point source" discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized State (EPA has authorized approximately forty States to administer the NPDES program), contain industry-specific, technology-based and/or water quality-based limits, and establish pollutant monitoring requirements. A facility that intends to discharge into the nation's waters must obtain a permit prior to initiating its discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set forth the conditions and effluent limitations under which a facility may make a discharge.

A NPDES permit may also include discharge limits based on Federal or State water quality criteria or standards, that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technological standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from State to State, and site to site, depending on the use classification of the receiving body of water. Most States follow EPA guidelines which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges

In 1987 the CWA was amended to require EPA to establish a program to address **storm water discharges**. In response, EPA promulgated the NPDES storm water permit application regulations. Storm water discharge associated with industrial activity means the discharge from any conveyance which is used for collecting and conveying storm water and which is directly related to manufacturing, processing, or raw material storage areas at an industrial plant (40 CFR 122.26(b)(14)). These regulations require that facilities with the following storm water discharges apply for an NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the State determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

The term "storm water discharge associated with industrial activity" means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR 122.26. Six of the categories are defined by SIC codes while the other five are identified through narrative descriptions of the regulated industrial activity. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges from those areas where the activities occur are subject to storm water discharge permit application requirements.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, consult the regulation.

Category i: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 291-petroleum refining; and SIC 311-leather tanning and finishing.

Category iii: Facilities classified as SIC 10-metal mining; SIC 12-coal mining; SIC 13-oil and gas extraction; and SIC 14-nonmetallic mineral mining.

Category iv: Hazardous waste treatment, storage, or disposal facilities.

Category v: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

Category vi: Facilities classified as SIC 5015-used motor vehicle parts; and SIC 5093-automotive scrap and waste material recycling facilities.

Category vii: Steam electric power generating facilities.

Category viii: Facilities classified as SIC 40-railroad transportation; SIC 41-local passenger transportation; SIC 42-trucking and warehousing (except public warehousing and storage); SIC 43-U.S. Postal Service; SIC 44-water transportation; SIC 45-transportation by air; and SIC 5171-petroleum bulk storage stations and terminals.

Category ix: Sewage treatment works.

Category x: Construction activities except operations that result in the disturbance of less than five acres of total land area.

Category xi: Facilities classified as SIC 20-food and kindred products; SIC 21-tobacco products; SIC 22-textile mill products; SIC 23-apparel related products; SIC 2434-wood kitchen cabinets manufacturing; SIC 25-furniture and fixtures; SIC 265-paperboard containers and boxes; SIC 267-converted paper and paperboard products; SIC 27-printing, publishing, and allied industries; SIC 283-drugs; SIC 285-paints, varnishes, lacquer, enamels, and allied products; SIC 30-rubber and plastics; SIC 31-leather and leather products (except leather and tanning and finishing); SIC 323-glass products; SIC 34-fabricated metal products (except fabricated structural metal); SIC 35-industrial and commercial machinery and computer equipment; SIC 36-electronic and other electrical equipment and components; SIC 37-transportation equipment (except ship and boat building and repairing); SIC 38-measuring, analyzing, and controlling instruments; SIC 39-miscellaneous manufacturing industries; and SIC 4221-4225-public warehousing and storage.

Pretreatment Program

Another type of discharge that is regulated by the CWA is one that goes to a publicly-owned treatment works (POTWs). The national **pretreatment program** (CWA §307(b)) controls the indirect discharge of pollutants to POTWs by "industrial users." Facilities regulated under §307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the quality of sludge generated by these plants. Discharges to a POTW are regulated primarily by the POTW itself, rather than the State or EPA.

EPA has developed technology-based standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a State is authorized to implement either the NPDES or the pretreatment program, if it develops its own program, it may enforce requirements more stringent than Federal standards.

Spill Prevention, Control and Countermeasure Plans

The 1990 Oil Pollution Act requires that facilities posing a substantial threat of harm to the environment prepare and implement more rigorous Spill Prevention Control and Countermeasure (SPCC) Plan required under the CWA (40 CFR §112.7). As iron and steel manufacturing is an energy intensive industry, an important requirement affecting iron and steel facilities is oil response plans for above ground storage. There are also criminal and civil penalties for deliberate or negligent spills of oil. Regulations covering response to oil discharges and contingency plans (40 CFR Part 300), and Facility Response Plans to oil discharges (40 CFR Part 112) and for PCB transformers and PCB-containing items are being revised and finalized in 1995.[29]

EPA's Office of Water, at (202) 260-5700, will direct callers with questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed through the Ground Water and Drinking Water resource center, at (202) 260-7786.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint Federal-State system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water through the control of underground injection of liquid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized States enforce the primary drinking water standards, which are, contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set as close to MCLGs as possible, considering cost and feasibility of attainment.

The SDWA **Underground Injection Control** (UIC) program (40 CFR Parts 144-148) is a permit program which protects underground sources of drinking water by regulating five classes of injection wells. UIC permits include design, operating, inspection, and monitoring requirements. Wells used to inject hazardous wastes must also comply with RCRA corrective action standards in order to be granted a RCRA permit, and must meet applicable RCRA land disposal restrictions standards. The UIC permit program is primarily State-enforced, since EPA has authorized all but a few States to administer the program.

The SDWA also provides for a Federally-implemented Sole Source Aquifer program, which prohibits Federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a State-implemented Wellhead Protection program, designed to protect drinking water wells and drinking water recharge areas.

EPA's Safe Drinking Water Hotline, at (800) 426-4791, answers questions and distributes guidance pertaining to SDWA standards. The Hotline operates from 9:00 a.m. through 5:30 p.m., ET, excluding Federal holidays.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk.

TSCA standards may apply at any point during a chemical's life cycle. Under TSCA §5, EPA has established an inventory of chemical substances. If a chemical is not already on the inventory, and has not been excluded by TSCA, a premanufacture notice (PMN) must be submitted to EPA prior to manufacture or import. The PMN must identify the chemical and provide available information on health and environmental effects. If available data are not sufficient to evaluate the chemicals effects, EPA can impose restrictions pending the development of information on its health and environmental effects. EPA can also restrict significant new uses of chemicals based upon factors such as the projected volume and use of the chemical.

Under TSCA §6, EPA can ban the manufacture or distribution in commerce, limit the use, require labeling, or place other restrictions on chemicals that pose unreasonable risks. Among the chemicals EPA regulates under §6 authority are asbestos, chlorofluorocarbons (CFCs), and polychlorinated biphenyls (PCBs).

EPA's TSCA Assistance Information Service, at (202) 554-1404, answers questions and distributes guidance pertaining to Toxic Substances Control Act standards. The Service operates from 8:30 a.m. through 4:30 p.m., ET, excluding Federal holidays.

Clean Air Act

The Clean Air Act (CAA) and its amendments, including the Clean Air Act Amendments (CAAA) of 1990, are designed to "protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population." The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA and the States to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAAA, many facilities will be required to obtain permits for the first time. State and local governments oversee, manage, and enforce many of the requirements of the CAAA. CAA regulations appear at 40 CFR Parts 50-99.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQSs) to limit levels of "criteria pollutants," including carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide. Geographic areas that meet NAAQSs for a given pollutant are classified as attainment areas; those that do not meet NAAQSs are classified as non-attainment areas. Under §110 of the CAA, each State must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet Federal air quality standards.

Title I also authorizes EPA to establish New Source Performance Standards (NSPSs), which are nationally uniform emission standards for new stationary sources falling within particular industrial categories. NSPSs are based on the pollution control technology available to that category of industrial source but allow the affected industries the flexibility to devise a cost-effective means of reducing emissions.

Under Title I, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAPs), nationally uniform standards oriented towards controlling particular hazardous air pollutants (HAPs). Title III of the CAAA further directed EPA to develop a list of sources that emit any of 189 HAPs, and to develop regulations for these categories of sources. To date EPA has listed 174 categories and developed a schedule for the establishment of emission standards. The emission standards will be developed for both new and existing sources based on "maximum achievable control technology" (MACT)." The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV establishes a sulfur dioxide nitrous oxide emissions program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances, which, beginning in 1995, will be set below previous levels of sulfur dioxide releases.

Title V of the CAAA of 1990 created a permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States are developing the permit programs in accordance with guidance and regulations from EPA. Once a State program is approved by EPA, permits will be issued and monitored by that State.

Title VI is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restrict their use and distribution. Production of Class I substances, including 15 kinds of chlorofluorocarbons (CFCs), will be phased out entirely by the year 2,000, while certain hydrochlorofluorocarbons (HCFCs) will be phased out by 2030.

EPA's Control Technology Center, at (919) 541-0800, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at (800) 296-1996, provides general information about regulations promulgated under Title VI of the CAA, and EPA's EPCRA Hotline, at (800) 535-0202, answers questions about accidental release prevention under CAA §112(r). In addition, the Technology Transfer Network Bulletin Board System (modem access (919) 541-5742)) includes recent CAA rules, EPA guidance documents, and updates of EPA activities.

VI.B. Industry Specific Regulatory Requirements

The steel industry has invested substantial resources in compliance with environmental regulations. Expenditures for environmental air control totaled $279 million in 1991, while water and solid waste control combined totaled $66 million. This translates to 15 percent of total capital expenditures for the industry in 1991. The high percentage of total environmental capital expenditures for air control (81 percent) is primarily due to keeping coke ovens operating in compliance with the Clean Air Act. Although coke ovens are considered by many industry experts to be the biggest environmental problem of the iron and steel industry, environmental regulations affect the industry throughout all stages of the manufacturing and forming processes. An overview of how federal environmental regulations affect this industry follows.

Clean Air Act (CAA)

The CAA, with its 1990 amendments (CAAA), regulates the pollutants that steel mills can add to the air. Title I of the Act addresses requirements for the attainment and maintenance of the National Ambient Air Quality Standards (NAAQS) (40 CFR, §50). EPA has set NAAQS for six criteria pollutants, which states must plan to meet through state implementation plans (SIPs). NAAQS for nitrogen dioxide, lead, and particulate matter frequently affect the iron and steel industry.

One of the most significant impacts of the CAAA on the iron and steel industry is tied to the standards developed for toxic air emissions or Hazardous Air Pollutants (HAPs). For the steel industry, these standards, National Emission Standards for Hazardous Air Pollutants (NESHAPs), have a significant effect on the industry's coke ovens. In late 1991, the coking industry entered into a formal regulatory negotiation with EPA and representatives of environmental groups, state and local air pollution control agencies, and the steelworkers union to develop a mutually acceptable rule to implement the terms of the Act's coke oven provisions. After a year of discussions, an agreement on a negotiated rule was signed. In exchange for a standard that is structured to give operators certainty and flexibility in the manner they demonstrate compliance, the industry agreed to daily monitoring, to install flare systems to control upset events, and to develop work practice plans to minimize emissions. National Emissions Standards currently in effect that pertain to the iron and steel industry include:

- Coke Oven Batteries (40 CFR §63 Subpart L). As of April 1, 1992, there were 30 plants with 87 by-product coke oven batteries that would be affected by this regulation.

- Benzene Emissions from Coke By-product Recovery Plants (40 CFR §61 Subpart L). Regulates benzene sources in coke by-product recovery operations by requiring that specified equipment be enclosed and the emissions be ducted to an enclosed point in the by-product recovery process where they are recovered or destroyed. Monitoring requirements are also stated.

- Halogenated Solvent Cleaning (40 CFR §63 Subpart T). Emission standards for the source categories listed in §112(d), including solvents used in the iron and steel industry such as 1,1,1-trichloroethane, trichloroethylene, and methylene chloride.

- Chromium - Industrial Process Cooling Towers (40 CFR §63 Subpart Q). This standard will eliminate chromium emissions from industrial process cooling towers. Industrial process cooling towers using chromate-based water treatment programs have been identified as potentially significant sources of chromium air emissions; chromium compounds being among the substances listed as HAPs in §112(e).

The CAA also impacts the minimill segment of the industry. The Electric Arc Furnace was identified as a possible source of hazardous air pollutants subject to a MACT determination, however, EPA data indicates that the impact is much less than originally anticipated and there are currently no plans for establishing a MACT standard.

The 1990 CAAA New Source Review (NSR) requirements apply to new facilities, expansions of existing facilities, or process modifications. New sources of the "criteria" pollutants regulated by the NAAQS in excess of levels defined by EPA as "major" are subject to NSR requirements (40 CFR Section 52.21(b)(1)(i)(a)-(b)). NSRs are typically conducted by the state agency under standards set by EPA and adopted by the state as part of its state implementation plan (SIP). There are two types of NSRs: Prevention of Significant Deterioration (PSD) reviews for facilities in areas that are meeting the NAAQS, and Nonattainment (NA) reviews for areas that are violating the NAAQS. Permits are required to construct or operate the new source for PSD and NA areas.

For NA areas, permits require the new source to meet the lowest achievable emission rate (LAER) standards and the operator of the new source must procure reductions in emissions of the same pollutants from other sources in the NA area in equal or greater amounts to the new source. These "emission offsets" may be banked and traded through state agencies.

For PSD areas, permits require the best available control technology (BACT), and the operator or owner of the new source must conduct continuous on-site air quality monitoring for one year prior to the new source addition to determine the effects that the new emissions may have on air quality. This one year waiting period before construction can be disruptive to some mills' expansion plans. In several cases, mills looking to construct or expand have attempted to be reclassified as a "synthetic minor," where they ask the state to put tighter restrictions on their quantity of emissions allowed on their air permit. With these reduced emissions, they become a minor instead of a major source, thereby becoming exempt from the lengthy and expensive PSD review.

EPA sets the minimum standards for LAER and BACT for iron and steel mill NSRs in its new source performance standards (NSPS), 40 CFR 60:

- Standards of Performance for Steel Plants: Electric Arc Furnaces (40 CFR §60, Subpart AA). Regulates the opacity and particulate matter in any gases discharged from EAFs constructed after October 21, 1974 and on or before August 17, 1983. Also requires a continuous monitoring system for the measurement of the opacity of emissions discharged from control equipment.

- Standards of Performance for Steel Plants: Electric Arc Furnaces and Argon-Oxygen Decarburization Vessels (AODs) (40 CFR §60, Subpart AAa). Regulates the opacity and particulate matter in any gases discharged from EAFs and AODs (used to blow argon and oxygen or nitrogen into molten steel for further refining) constructed after August 7, 1983. Also requires a continuous monitoring system for the measurement of the opacity of emissions discharged from EAF and AOD air pollution control equipment.

- Standards of Performance for Primary Emissions from Basic Oxygen Process Furnaces (BOPF) (40 CFR §60, Subpart N). Regulates the discharge of gases for particulate matter and opacity. These standards apply to BOPFs for which construction is commenced after June 11, 1973. Primary emissions refer to particulate matter emissions from the BOPF generated during the steel production cycle and captured by the BOPF primary control system.

- Standards of Performance for Secondary Emissions from Basic Oxygen Process Steelmaking Facilities (40 CFR §60, Subpart Na). Regulates the discharge of gases for particulate matter and opacity for BOPFs for which construction is commenced after January 20, 1983. Secondary emissions means particulate matter emissions that are not captured by the BOPF primary control system.

Clean Water Act (CWA)

The steel industry is a major water user and 40 CFR 420 established Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category. These are implemented through the NPDES permit program and through state and local pretreatment programs. Part 420 contains production-based effluent limitations guidelines and standards, therefore steel mills with higher levels of production will receive higher permit discharge allowances. The regulation contains 12 subparts for 12 distinct manufacturing processes:

A. Cokemaking	G. Hot Forming
B. Sintering	H. Salt Bath Descaling
C. Ironmaking	I. Acid Pickling
D. Steelmaking	J. Cold Forming
E. Vacuum Degassing	K. Alkaline Cleaning
F. Continuous Casting	L. Hot Coating

The pollutants regulated by 40 CFR 420 are divided into three categories:

1. *Conventional Pollutants:* Total Suspended Solids, Oil and Grease, pH
2. *Nonconvention Pollutants:* Ammonia-N, Phenols
3. *Priority or Toxic Pollutants:* Total cyanide, total chromium, hexavalent chromium, total lead, total nickel, total zinc, benzene, benzo(a)pyrene, naphthalene, tertrachloroethylene.

Wastewater is often recycled "in-plant" and at the "end-of-pipe" to reduce the volume of discharge. Process wastewater is usually filtered, and/or clarified on-site before being directly or indirectly discharged. Oil and greases are removed from the process wastewater by several methods which include oil skimming, filtration, and air flotation. These oils can then be used as lubricants and preservative coatings. The remaining sludge contains waste metals and organic chemicals. Iron in the sludges can be recovered and reclaimed through sintering and pelletizing operations. Many steel mills discharge industrial waste water through sewers to publicly owned treatment works.

The Storm Water Rule (40 CFR 122.26(b)(14) subparts (i, ii)) requires the capture and treatment of storm water at primary metal industry facilities including iron and steel manufacturing. Management of storm water will reduce discharges with respect to conventional pollutants (suspended solids and biological oxygen demand (BOD)), as well as other pollutants, such as certain metals and oil and grease.

Resource Conservation and Recovery Act (RCRA)

Several RCRA-listed wastes are produced during coke, iron, and steelmaking, forming, and cleaning/descaling operations. These wastes are identified below by process.

Coke Manufacturing

- Tar residues (K035, K087, K141, K142, and K147)
- Oil (K143 and K144)
- Naphthalene residues (K145)
- Lime sludge (K060)
- Wastewater sump residues containing benzene and polynuclear aromatic hydrocarbons (K144)
- Coke oven gas condensate from transfer and distribution lines

Iron and Steel Manufacturing

- EAF emission control dust and sludge (K061). Annually, 550,000 short tons of K061 are produced; 90 percent of this waste (500,000 short tons) is managed for metal recovery.[29]

Finishing

- Wastewater sludge from cooling, descaling, and rinsing (D006, D007, D008, D009, D010, and D011)
- Spent pickle liquor (K062). An exemption for this waste is detailed in 40 CFR 261.3(c)(2)(ii)(A). 904,945 short tons of K062 are generated annually in the U.S. and 52 percent of this waste is managed for recovery of iron, chromium, and nickel.[30]

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

The metals and metal compounds used in steelmaking, as well as steelmaking process chemicals, are often found in steel mills' air emissions, water discharges, or waste shipments for off-site disposal include chromium, manganese, nickel copper, zinc, lead, sulfuric acid, and hydrochloric acid. Metals are frequently found at CERCLA's problem sites. When Congress ordered EPA and the Public Health Service's Agency for Toxic Substances and Disease Registry (ATSDR) to list the hazardous substances most commonly found at problem sites and that pose the greatest threat to human health, lead, nickel, and aluminum all made the list.[31] Several sites of former steel mills are on the National Priorities List. Compliance with the requirements of RCRA lessens the chances that CERCLA compliance will be an issue in the future.

VI.C. Pending and Proposed Regulatory Requirements

The iron and steel industry has been identified in the Source Reduction Review Project (SRRP) as an industry for which a more integrated (across environmental media) approach to rulemaking is warranted. Efforts such as the Office of Water's review of the need for revised effluent guidelines for the industry (described below) and the technology-based standards for coke oven emissions under the Clean Air Act Amendments will be coordinated among several media offices.

Clean Air Act

Even with the flexibility the industry gained through the formal negotiations to develop the rule to implement the coke oven provisions of the CAA, coke-producing steel companies face difficult decisions of how best to utilize scarce capital to meet the CAAA standards. Additionally, coke oven operators still face unknown technology-based standards in 2010 and risk-based standards in 2020.

The Act's air toxic provisions will also ultimately have other major impacts. Included on the list of chemicals under the air toxics program are compounds of chromium, nickel, manganese, cadmium and other heavy metals. Because many of these metals are routinely found in iron ore, scrap, and alloying materials that are processed in iron and steel plants, most steelmaking processes will be affected in some way. EPA's priority list of source categories calls for the development of regulations for most of these sources by 2000, but until EPA identifies the technology corresponding to MACT for these sources and promulgates regulations, it is difficult to determine the additional impacts and costs to the industry for this program.

Tightening the national ambient air quality standard for particulate matter (PM-10) may also affect the iron and steel industry. Under the CAAA, EPA will be reviewing the basis for the existing ambient air PM-10 standard. A lower standard may cause more areas of the country to be classified as non-attainment areas and would trigger requirements for states to impose much more stringent emission control standards for sources of particulate matter, including iron and steel sources.

Hydrochloric acid and chlorine are among the pollutants listed as hazardous air pollutants in §112 of the CAAA. Steel pickling processes that use hydrochloric acid have been identified by the EPA as potentially significant sources of hydrochloric acid and chlorine air emissions and, as such, a source category for which national emission standards are likely. EPA is expected to make a determination on the steel pickling process sometime in 1995, with the final rule promulgation scheduled for 11/96. Many facilities either are already in compliance, or they have the required control equipment, but need to upgrade it or perform maintenance procedure to come into compliance. (Contact: James Maysilles, EPA Office of Air Quality Planning and Standards, 919-541-3265).

Title III of the CAAA, requires EPA to develop national emission standards for hazardous air pollutants (NESHAP) from specific stationary sources including iron and steel mills (contact: Phil Murine, EPA Office of Air Quality Planning and Standards, 919-541-5289) and iron and steel foundries (contact: James Maysilles, EPA Office of Air Quality Planning and Standards, 919-541-3265). Both of these types of facilities have been identified by the EPA as potentially significant sources of air emissions of substances that are among the pollutants listed as hazardous air pollutants in §112 of the CAAA. As such, these industries may be source categories for which national emission standards may be warranted. In integrated iron and steel mills, air emission of HAPs may include compounds of chromium, lead, manganese, and polycyclic organic matter, in quantities sufficient to designate these facilities as major sources. Emission standards were to be developed for Electric Arc Furnaces also. However, EPA data does not show that EAFs emit sufficient hazardous pollutants to include them on the list of major sources of these pollutants. Therefore, a proposed regulatory action is scheduled to remove this category from the list of sources where new regulations will be promulgated.

Other, more general, proposed regulatory actions under the CAA have an effect on some facilities within the iron and steel industry. These include:

• Risk Management Program for Chemical Accidental Release Prevention (40 CFR 68). Requires facilities where a regulated substance is present (defined by the list, with threshold quantities, promulgated under §112(r)(3)) to prepare and implement a risk management plan and provide emergency response. The final rule will be promulgated by 3/29/96.

• New Source Review Reform (40 CFR 51, 52). This action will amend the new source review regulations to reduce the level of program complexity. The final rule will be promulgated 1/96.

• Revised New Source Performance Standard for NOx (40 CFR 60, Subpart Db). Revisions apply to NOx emissions from fossil fuel-fired steam generating units, including industrial boilers and must reflect improvements in NOx reduction methods. The final rule will be promulgated by 12/31/96.

• Title V Federal Air Operating Permit Rules (40 CFR 70 and 71). Sets requirements for state permitting programs for major stationary air pollutants. Also establishes a federal permitting program for use where states fail to establish or implement an adequate program. The final rule will be promulgated by 11/95.

• Title V State Air Operating Permit Rules (40 CFR 70). Revisions of the state operating permit rules promulgated in 1992. This regulation is intended to restructure the process for issuing and revising permits, to give state agencies more flexibility. States will be allowed to issue a single permit covering both New Source Review and Title V permitting requirements.

Clean Water Act (CWA)

Since approximately 80 percent of the nation's integrated steelmaking capacity is located in the Great Lakes states, the current efforts to develop uniform water quality standards under the Great Lakes Water Quality Initiative may have a significant impact on the industry. According to the American Iron and Steel Institute (AISI), the industry is concerned with the establishment of uniform water quality guidance for all waters. AISI believes that states should be given the responsibility of designating uses and associated water quality standards for all water bodies within their jurisdictions. These designations, AISI believes, should take into account the feasibility of the attainment of swimmable and fishable waters where naturally occurring pollutants prevent its attainment, where pollution sources prevent attainment and correction of these sources would cause more environmental harm than good, or where attainment would result in unreasonable social and economic impacts. AISI concludes that requiring discharges of non-contact cooling water to be cleaner than when drawn from the stream or lake, while at the same time disregarding the water quality impacts of non-point sources such as urban or agricultural runoff, will impose huge costs, restrict growth, or force zero discharge on direct dischargers. By March 23, 1997, the Great lakes states (Illinois, Indiana, Michigan, Minnesota, New York, Pennsylvania, Ohio, and Wisconsin), as well as tribes in the area, must adopt rules and procedures consistent with the Water Quality Guidance for the Great Lakes System (40 CFR 132; also amends 122, 123, and 131). The Guidance places particular emphasis on decreasing bioaccumulative toxics and also provides a process for addressing both point and non-point source pollution.

The EPA is currently revisiting the CWA Effluent Guidelines and Standards for Iron and Steel Manufacturing Point Source Category. A two-year study is scheduled to be completed in late 1995 which reviews the existing regulations to determine what changes have been made in the industry since the 1982 regulations were promulgated. One focus of the project is to investigate the types of pollution prevention measures that have been implemented. The study was initiated as a result of a Natural Resources Defense Council (NRDC) consent decree. (Contact: George Jett, EPA Office of Water, 202-260-7151).

The Office of Water is also initiating a 3-year data collection and analysis effort (which began in 1994) to quantify the adverse impacts from cooling water intake structures and the efficacy of certain control mechanisms. Regulatory options will be developed and a regulation proposed based on the study results. This regulation may have a relatively significant impact on the iron and steel industry.

Resource Conservation and Recovery Act (RCRA)

Under RCRA, emission control dust and sludge from electric arc furnaces (EAF) are a listed hazardous waste (K061) and are subject to land disposal restrictions. This pollution control dust/sludge is composed of various metals: primarily iron with lesser concentrations of zinc, lead, cadmium, and sometimes nickel and chromium. The metals primarily recovered are iron or nickel alloys or zinc. Two or the primary hazardous constituents, lead and cadmium, are not initially recovered, although they are usually shipped off-site for further recovery. Annually, 550,000 short tons of K061 are produced; 90 percent of this waste (500,000 short tons) is managed for metal recovery.[32] EPA's treatment standards were originally based on high temperature metals recovery, but were recently revised to generic treatment levels. As a result, a generator may select one of a variety of options, including stabilization, as alternatives to recycling. Other recovery alternatives include: use as a fertilizer ingredient, use an ingredient in glass grit for abrasive blast, roofing shingles, glass ceramic or ceramic glaze, use as an ingredient in the production of cement, use as an ingredient in the production of special aggregates.[33]

Such recovery practices reduce the quantity of hazardous waste disposed of, however, the industry is concerned with the limitations that are placed on the disposal or uses of non-hazardous residuals from the high temperature metals recovery processes that might serve to discourage or inhibit metal recovery practices. According to several steel industry trade associations (SMA, SSINA, AISI), RCRA has discouraged metal recovery from hazardous wastes generated in steel production. For example, the derived-from rule has discouraged investment in on-site or regional recycling operations because of the additional cost of residual management. The trade associations also state that the lack of adequate metal recovery capacity in the U.S. requires their members to spend an average of $650,000 annually in transportation costs to ship K061 off-site, and a total of $1.4 million annually to recycle K061.[34] Other RCRA impediments stated by the trade associations include the 90-day storage limit for generators, and corrective action/financial assurance.

As part of a 1992 settlement agreement, EPA has agreed to propose (by June 30, 1995) and promulgate (by June 30, 1996) regulations for land disposal restrictions on mineral processing wastes. These regulations will set land disposal restrictions and standards for those mineral processing wastes that are found to be hazardous under RCRA Subtitle C. Currently, all extraction and beneficiation wastes, as well as 20 mineral processing wastes, are exempt from federal hazardous waste regulations.

Under a proposed regulation, "Hazardous Waste Management System: Amendment to Generic Exclusion for Encapsulated Uses (K061, K062, F006)," (40 CFR 261), the slags created from the treatment of pollution control dusts resulting from scrap metal recycling (i.e., electric arc furnace dust), will be reclassified as nonhazardous and be allowed for road-related uses if the toxic metals in the wastes have been reduced to safe levels by treatment. The final rule will be promulgated by 6/13/96.

Also under RCRA Subtitle C (40 CFR 261), the "Hazardous Waste Identification Rule" will be proposed in 1995 to allow listed wastes which are low risk to be removed from the hazardous waste regulatory scheme. This rule is intended to better align the burden of RCRA regulation with the risks being controlled.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

Steel companies involved in Superfund sites would be affected by changes under impending CERCLA reauthorization. Questions of liability, funding mechanisms, selection of remedial actions, and application of risk concepts are all of concern to the steel industry.

Safe Drinking Water Act (SDWA)

The 1986 SDWA amendments required EPA to complete a study of Class V underground injection wells. These are all wells not included in Classes I through IV; they vary from simple septic systems and shallow cesspools to deep, technically sophisticated wells with a wide range of environmental impacts. As a follow up to the study, EPA developed a strategy to assess whether additional controls of these wells would be appropriate. A proposed regulation on Class V wells is being developed as part of this strategy and could potentially affect some iron and steel facilities. Final rule promulgation is scheduled for 11/96.

Global Climate Change

Legislative initiatives that address global climate change will also affect the iron and steel industry. Steel is a highly energy intensive industry, where 15 to 20 percent of the manufacturing cost of steel is for energy. Most of that energy is derived from coal, principally in the form of coke. Consequently, a carbon tax could have a major impact on the steel industry. While such a tax is designed to reduce carbon dioxide emissions and to curb energy consumption, industry analysts expect such a tax would also results in 177,000 to 362,000 job losses across the country, according to Wilbur Steger, president of CONSAD Research Corp., as reported in the March 1993 issue of *Iron Age*.

Increasing the corporate average fuel economy (CAFE) of automobiles has been identified as a means of encouraging energy conservation and reducing carbon dioxide emissions. An increase in fuel economy standards may lead to downsizing automobiles, which will affect steel markets by reducing demand for certain steel products.

VII. COMPLIANCE AND ENFORCEMENT HISTORY

Background

To date, EPA has focused much of its attention on measuring compliance with specific environmental statutes. This approach allows the Agency to track compliance with the Clean Air Act, the Resource Conservation and Recovery Act, the Clean Water Act, and other environmental statutes. Within the last several years, the Agency has begun to supplement single-media compliance indicators with facility-specific, multimedia indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level, and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's Integrated Data for Enforcement Analysis (IDEA) system. IDEA has the capacity to "read into" the Agency's single-media databases, extract compliance records, and match the records to individual facilities. The IDEA system can match Air, Water, Waste, Toxics/Pesticides/EPCRA, TRI, and Enforcement Docket records for a given facility, and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder. As the capacity to generate multimedia compliance data improves, EPA will make available more in-depth compliance and enforcement information. Additionally, sector-specific measures of success for compliance assistance efforts are under development.

Compliance and Enforcement Profile Description

Using inspection, violation and enforcement data from the IDEA system, this section provides information regarding the historical compliance and enforcement activity of this sector. In order to mirror the facility universe reported in the Toxic Chemical Profile, the data reported within this section consists of records only from the TRI reporting universe. With this decision, the selection criteria are consistent across sectors with certain exceptions. For the sectors that do not normally report to the TRI program, data have been provided from EPA's Facility Indexing System (FINDS) which tracks facilities in all media databases. Please note, in this section, EPA does not attempt to define the actual number of facilities that fall within each sector. Instead, the section portrays the records of a subset of facilities within the sector that are well defined within EPA databases.

As a check on the relative size of the full sector universe, most notebooks contain an estimated number of facilities within the sector according to the Bureau of Census (See Section II). With sectors dominated by small businesses, such as metal finishers and printers, the reporting universe within the EPA databases may be small in comparison to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general make-up.

Following this introduction is a list defining each data column presented within this section. These values represent a retrospective summary of inspections and enforcement actions, and solely reflect EPA, State, and local compliance assurance activities that have been entered into EPA databases. To identify any changes in trends, the EPA ran two data queries, one for the past five calendar years (August 10, 1990 to August 9, 1995) and the other for the most recent twelve-month period (August 10, 1994 to August 9, 1995). The five-year analysis gives an average level of activity for that period for comparison to the more recent activity.

Because most inspections focus on single-media requirements, the data queries presented in this section are taken from single media databases. These databases do not provide data on whether inspections are state/local or EPA-led. However, the table breaking down the universe of violations does give the reader a crude measurement of the EPA's and states' efforts within each media program. The presented data illustrate the variations across regions for certain sectors.[d] This variation may be attributable to state/local data entry variations, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Hence, the exhibited data do not rank regional performance or necessarily reflect which regions may have the most compliance problems.

Compliance and Enforcement Data Definitions

General Definitions

Facility Indexing System (FINDS) -- this system assigns a common facility number to EPA single-media permit records. The FINDS identification number allows EPA to compile and review all permit, compliance, enforcement and pollutant release data for any given regulated facility.

Integrated Data for Enforcement Analysis (IDEA) -- is a data integration system that can retrieve information from the major EPA program office databases. IDEA uses the FINDS identification number to "glue together" separate data records from EPA's databases. This is done to create a "master list" of data records for any given facility. Some of the data systems accessible through IDEA are: AIRS (Air Facility Indexing and Retrieval System, Office of Air and Radiation), PCS (Permit Compliance System, Office of Water), RCRIS (Resource Conservation and Recovery Information System, Office of Solid Waste), NCDB (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental and Liability Information System, Superfund),

[d] EPA Regions include the following states: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V (IL, IN, MI, MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IA, KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); X (AK, ID, OR, WA).

and TRIS (Toxic Release Inventory System). IDEA also contains information from outside sources such as Dun and Bradstreet and the Occupational Safety and Health Administration (OSHA). Most data queries displayed in notebook sections IV and VII were conducted using IDEA.

Data Table Column Heading Definitions

Facilities in Search -- are based on the universe of TRI reporters within the listed SIC code range. For industries not covered under TRI reporting requirements, the notebook uses the FINDS universe for executing data queries. The SIC code range selected for each search is defined by each notebook's selected SIC code coverage described in Section II.

Facilities Inspected --- indicates the level of EPA and state agency inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a 12 or 60 month period.

Number of Inspections -- measures the total number of inspections conducted in this sector. An inspection event is counted each time it is entered into a single media database.

Average Time Between Inspections -- provides an average length of time, expressed in months, between compliance inspections at a facility within the defined universe.

Facilities with One or More Enforcement Actions -- expresses the number of facilities that were the subject of at least one enforcement action within the defined time period. This category is broken down further into federal and state actions. Data are obtained for administrative, civil/judicial, and criminal enforcement actions. Administrative actions include Notices of Violation (NOVs). A facility with multiple enforcement actions is only counted once in this column (facility with 3 enforcement actions counts as 1).

Total Enforcement Actions -- describes the total number of enforcement actions identified for an industrial sector across all environmental statutes. A facility with multiple enforcement actions is counted multiple times (a facility with 3 enforcement actions counts as 3).

State Lead Actions -- shows what percentage of the total enforcement actions are taken by state and local environmental agencies. Varying levels of use by states of EPA data systems may limit the volume of actions accorded state enforcement activity. Some states extensively report enforcement activities into EPA data systems, while other states may use their own data systems.

Federal Lead Actions -- shows what percentage of the total enforcement actions are taken by the United States Environmental Protection Agency. This value includes referrals from state agencies. Many of these actions result from coordinated or joint state/federal efforts.

Enforcement to Inspection Rate -- expresses how often enforcement actions result from inspections. This value is a ratio of enforcement actions to inspections, and is presented for comparative purposes only. This measure is a rough indicator of the relationship between inspections and enforcement. This measure simply indicates historically how many enforcement actions can be attributed to inspection activity. Reported inspections and enforcement actions under the Clean Water Act (CWA), the Clean Air Act (CAA) and the Resource Conservation and Recovery Act (RCRA) are included in this ratio. Inspections and actions from the TSCA/FIFRA/ EPCRA database are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. This ratio does not account for enforcement actions arising from non-inspection compliance monitoring activities (e.g., self-reported water discharges) that can result in enforcement action within the CAA, CWA, and RCRA.

Facilities with One or More Violations Identified -- indicates the percentage of inspected facilities having a violation identified in one of the following data categories: In Violation or Significant Violation Status (CAA); Reportable Noncompliance, Current Year Noncompliance, Significant Noncompliance (CWA); Noncompliance and Significant Noncompliance (FIFRA, TSCA, and EPCRA); Unresolved Violation and Unresolved High Priority Violation (RCRA). The values presented for this column reflect the extent of noncompliance within the measured time frame, but do not distinguish between the severity of the noncompliance. Violation status may be a precursor to an enforcement action, but does not necessarily indicate that an enforcement action will occur.

Media Breakdown of Enforcement Actions and Inspections -- four columns identify the proportion of total inspections and enforcement actions within EPA Air, Water, Waste, and TSCA/FIFRA/EPCRA databases. Each column is a percentage of either the "Total Inspections," or the "Total Actions" column.

VII.A. Iron and Steel Industry Compliance History

Exhibit 14 provides an overview of the reported compliance and enforcement data for the iron and steel industry over the past five years (August 1990 to August 1995). These data are also broken out by EPA Region thereby permitting geographical comparisons. A few points evident from the data are listed below.

- Eighty-five percent of iron and steel facility inspections occurred in Regions III, IV, and V, where the most facilities are located.

- Within the three regions where iron and steel mills are concentrated, the proportion of state-lead enforcement actions was significantly greater than federal action for Regions III and IV (87% state-lead and 91% state-lead, respectively). In Region V, the region with the greatest number of iron and steel facilities, enforcement actions were fairly evenly split between state-lead and federal-lead.

- Of the 275 facilities inspected over the five-year period examined, 115 had one or more enforcement actions (42%), however, the aggregate Enforcement to Inspection Rate across all Regions was 0.14 (499 enforcement actions/3,555 inspections).

Exhibit 14: Five-Year Enforcement and Compliance Summary for Iron and Steel

A	B	C	D	E	F	G	H	I	J
Region	**Facilities in Search**	**Facilities Inspected**	**Number of Inspections**	**Average Months Between Inspections**	**Facilities with 1 or More Enforcement Actions**	**Total Enforcement Actions**	**Percent State Lead Actions**	**Percent Federal Lead Actions**	**Enforcement to Inspection Rate**
I	17	11	37	28	6	9	78%	22%	0.24
II	23	19	184	8	8	21	76%	24%	0.11
III	79	68	962	5	26	135	87%	13%	0.14
IV	59	46	907	4	24	133	87%	13%	0.15
V	135	92	1,143	7	36	98	48%	52%	0.09
VI	32	21	185	10	7	59	39%	61%	0.32
VII	10	7	43	14	2	7	14%	86%	0.16
VIII	5	3	29	10	2	6	83%	17%	0.21
IX	11	6	23	29	3	21	100%	0%	0.91
X	3	2	42	4	1	10	50%	50%	0.24
TOTAL	374	275	3,555	6	115	499	72%	28%	0.14

VII.B. Comparison of Enforcement Activity Between Selected Industries

Exhibits 15 and 16 allow the compliance history of the iron and steel sector to be compared to the other industries covered by the industry sector notebooks. Comparisons between Exhibits 15 and 16 permit the identification of trends in compliance and enforcement records of the industry by comparing data covering the last five years to that of the past year. Some points evident from the data are listed below.

- Of those sectors listed, facilities in iron and steel sector have been one of the most frequently inspected industries over the past five years with an average of 6 months between inspections. Only petroleum refining and pulp and paper facilities were inspected, on average, more frequently.

- Over the past year, the enforcement to inspection rate for the iron and steel industry has decreased from 0.14 for 1990 through 1995 to 0.09 for August 1994 through August 1995.

Exhibits 17 and 18 provide a more in-depth comparison between iron and steel industry and other sectors by breaking out the compliance and enforcement data by environmental statute. As in the previous Exhibits (Exhibits 15 and 16), the data cover the last five years (Exhibit 17) and the last one year (Exhibit 18) to facilitate the identification of recent trends. A few points evident from the data are listed below.

- The percentage of inspections carried out under each environmental statute has changed little between the average of the past five years and that of the past year. Inspections are roughly divided equally among, CAA, CWA, and RCRA, although the past year has shown a slight increase in the percentage of CAA inspections and a slight decrease in the percentage of RCRA inspections.

- While approximately one-third of inspections are carried out under each statute (CAA, CWA, and RCRA), the majority of the enforcement actions are taken under RCRA.

Exhibit 15: Five-Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E	F	G	H	I	J
Industry Sector	**Facilities in Search**	**Facilities Inspected**	**Number of Inspections**	**Average Months Between Inspections**	**Facilities with 1 or More Enforcement Actions**	**Total Enforcement Actions**	**Percent State Lead Actions**	**Percent Federal Lead Actions**	**Enforcement to Inspection Rate**
Pulp and Paper	306	265	3,766	5	115	502	78%	22%	0.13
Printing	4,106	1,035	4,723	52	176	514	85%	15%	0.11
Inorganic Chemicals	548	298	3,034	11	99	402	76%	24%	0.13
Organic Chemicals	412	316	3,864	6	152	726	66%	34%	0.19
Petroleum Refining	156	145	3,257	3	110	797	66%	34%	0.25
Iron and Steel	**374**	**275**	**3,555**	**6**	**115**	**499**	**72%**	**28%**	**0.14**
Dry Cleaning	933	245	633	88	29	103	99%	1%	0.16
Metal Mining	873	339	1,519	34	67	155	47%	53%	0.10
Non-Metallic Mineral Mining	1,143	631	3,422	20	84	192	76%	24%	0.06
Lumber and Wood	464	301	1,891	15	78	232	79%	21%	0.12
Furniture	293	213	1,534	11	34	91	91%	9%	0.06
Rubber and Plastic	1,665	739	3,386	30	146	391	78%	22%	0.12
Stone, Clay, and Glass	468	268	2,475	11	73	301	70%	30%	0.12
Fabricated Metal	2,346	1,340	5,509	26	280	840	80%	20%	0.15
Nonferrous Metal	844	474	3,097	16	145	470	76%	24%	0.15
Electronics	405	222	777	31	68	212	79%	21%	0.27
Automobiles	598	390	2,216	16	81	240	80%	20%	0.11

Exhibit 16: One-Year Inspection and Enforcement Summary for Selected Industries									
A	B	C	D	E		F		G	H
				Facilities with 1 or More Violations		Facilities with 1 or more Enforcement Actions			
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Number	Percent*	Number	Percent*	Total Enforcement Actions	Enforcement to Inspection Rate
Pulp and Paper	306	189	576	162	86%	28	15%	88	0.15
Printing	4,106	397	676	251	63%	25	6%	72	0.11
Inorganic Chemicals	548	158	427	167	106%	19	12%	49	0.12
Organic Chemicals	412	195	545	197	101%	39	20%	118	0.22
Petroleum Refining	156	109	437	109	100%	39	36%	114	0.26
Iron and Steel	**374**	**167**	**488**	**165**	**99%**	**20**	**12%**	**46**	**0.09**
Dry Cleaning	933	80	111	21	26%	5	6%	11	0.10
Metal Mining	873	114	194	82	72%	16	14%	24	0.13
Non-metallic Mineral Mining	1,143	253	425	75	30%	28	11%	54	0.13
Lumber and Wood	464	142	268	109	77%	18	13%	42	0.58
Furniture	293	160	113	66	41%	3	2%	5	0.55
Rubber and Plastic	1,665	271	435	289	107%	19	7%	59	0.14
Stone, Clay, and Glass	468	146	330	116	79%	20	14%	66	0.20
Nonferrous Metals	844	202	402	282	104%	22	11%	72	0.18
Fabricated Metal	2,346	477	746	525	110%	46	10%	114	0.15
Electronics	405	60	87	80	133%	8	13%	21	0.24
Automobiles	598	169	284	162	96%	14	8%	28	0.10

* Percentages in Columns E and F are based on the number of facilities inspected (Column C). Percentages can exceed 100% because violations and actions can occur without a facility inspection.

Exhibit 17: Five-Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Facilities Inspected	Total Inspections	Total Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspection	% of Total Actions
Pulp and Paper	265	3,766	502	51%	48%	38%	30%	9%	18%	2%	3%
Printing	1,035	4,723	514	49%	31%	6%	3%	43%	62%	2%	4%
Inorganic Chemicals	298	3,034	402	29%	26%	29%	17%	39%	53%	3%	4%
Organic Chemicals	316	3,864	726	33%	30%	16%	21%	46%	44%	5%	5%
Petroleum Refining	145	3,237	797	44%	32%	19%	12%	35%	52%	2%	5%
Iron and Steel	**275**	**3,555**	**499**	**32%**	**20%**	**30%**	**18%**	**37%**	**58%**	**2%**	**5%**
Dry Cleaning	245	633	103	15%	1%	3%	4%	83%	93%	0%	1%
Metal Mining	339	1,519	155	35%	17%	57%	60%	6%	14%	1%	9%
Non-metallic Mineral Mining	631	3,422	192	65%	46%	31%	24%	3%	27%	0%	4%
Lumber and Wood	301	1,891	232	31%	21%	8%	7%	59%	67%	2%	5%
Furniture	293	1,534	91	52%	27%	1%	1%	45%	64%	1%	8%
Rubber and Plastic	739	3,386	391	39%	15%	13%	7%	44%	68%	3%	10%
Stone, Clay, and Glass	268	2,475	301	45%	39%	15%	5%	39%	51%	2%	5%
Nonferrous Metals	474	3,097	470	36%	22%	22%	13%	38%	54%	4%	10%
Fabricated Metal	1,340	5,509	840	25%	11%	15%	6%	56%	76%	4%	7%
Electronics	222	777	212	16%	2%	14%	3%	66%	90%	3%	5%
Automobiles	390	2,216	240	35%	15%	9%	4%	54%	75%	2%	6%

Exhibit 18: One-Year Inspection and Enforcement Summary by Statute for Selected Industries											
				Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other	
Industry Sector	**Facilities Inspected**	**Total Inspections**	**Total Enforcement Actions**	**% of Total Inspections**	**% of Total Actions**	**% of Total Inspections**	**% of Total Actions**	**% of Total Inspections**	**% of Total Actions**	**% of Total Inspections**	**% of Total Actions**
Pulp and Paper	189	576	88	56%	69%	35%	21%	10%	7%	0%	3%
Printing	397	676	72	50%	27%	5%	3%	44%	66%	0%	4%
Inorganic Chemicals	158	427	49	26%	38%	29%	21%	45%	36%	0%	6%
Organic Chemicals	195	545	118	36%	34%	13%	16%	50%	49%	1%	1%
Petroleum Refining	109	437	114	50%	31%	19%	16%	30%	47%	1%	6%
Iron and Steel	**167**	**488**	**46**	**29%**	**18%**	**35%**	**26%**	**36%**	**50%**	**0%**	**6%**
Dry Cleaning	80	111	11	21%	4%	1%	22%	78%	67%	0%	7%
Metal Mining	114	194	24	47%	42%	43%	34%	10%	6%	0%	19%
Non-metallic Mineral Mining	253	425	54	69%	58%	26%	16%	5%	16%	0%	11%
Lumber and Wood	142	268	42	29%	20%	8%	13%	63%	61%	0%	6%
Furniture	293	160	5	58%	67%	1%	10%	41%	10%	0%	13%
Rubber and Plastic	271	435	59	39%	14%	14%	4%	46%	71%	1%	11%
Stone, Clay, and Glass	146	330	66	45%	52%	18%	8%	38%	37%	0%	3%
Nonferrous Metals	202	402	72	33%	24%	21%	3%	44%	69%	1%	4%
Fabricated Metal	477	746	114	25%	14%	14%	8%	61%	77%	0%	2%
Electronics	60	87	21	17%	2%	14%	7%	69%	87%	0%	4%
Automobiles	169	284	28	34%	16%	10%	9%	56%	69%	1%	6%

Major Cases/Supplemental Environmental Projects

This section provides summary information about major cases that have affected this sector, and a list of Supplemental Environmental Projects (SEPs). SEPs are compliance agreements that reduce a facility's non-compliance penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can significantly reduce the future pollutant loadings of a facility.

VII.C.1. Review of Major Cases

The Office of Regulatory Enforcement does not regularly compile information related to major cases and pending litigation within an industry sector. The staff are willing to pass along such information to Agency staff as requests are made. (Contact: Pete Rosenberg 202-260-8869) In addition, summaries of completed enforcement actions are published each fiscal year in the *Enforcement Accomplishments Report*; the summaries are not organized by industry sector. (Contact: Robert Banks 202-260-8296).

VII.C.2. Supplementary Environmental Projects (SEPs)

Supplemental environmental projects (SEPs) are enforcement options that require the non-compliant facility to complete specific projects. Regional summaries of SEPs undertaken in the 1993 and 1994 federal fiscal years were reviewed. Three projects were undertaken that involved iron and steel facilities, as shown in Exhibit 19.

In the iron and steel sector, SEPs resulted from violations of EPCRA, CERCLA, and RCRA. Due to differences in regional descriptions, the specifics of the original violations are not known. The cost for the projects ranged from $53,000 to $900,000 corresponding to initial penalties ranging from $110,000 to $746,438.

Exhibit 19: FY-1993-1994 Supplemental Environmental Projects Overview: Iron and Steel Manufacture

General Information				Violation Information					Pollution Reduction		
FY	Docket #	Company Name	State/ Region	Type	Initial Penalty	Final Penalty	SEP Credit	SEP Cost to Company	Pollutant Concern	Pollutant Reduction	Supplemental Environmental Project Description
93	---	Inland Steel Co.	IN	EPCRA 313	$260,000	$100,000	---	$165,000	Perchloro-ethylene	200,000 lbs/yr	Parts cleaning process modified by replacing perchloroethylene with a non-toxic
93	---	Follansbee Steel Division of the Louis Berkman Company	WV	CERCLA	$110,000	$72,250	$17,250	$53,000	Zinc compounds Sulfuric Acid	500 to 1,000 lb/yr air, 40,000 lb/yr zinc (100%)	Zinc preflux process eliminated and sulfuric acid spillage control installed
94	---	Indiana Steel and Wire/G.K. Technologies	IN	RCRA	$746,438	$425,000	---	$900,000	Ammonia	---	Will eliminate ammonia emissions through conversion of zinc plating line bath to eliminate the use of anhydrous ammonia

Violation Information Terms
Initial penalty: Initial proposed cash penalty for violation
Final penalty: Total penalty after SEP negotiation
SEP credit: Cash credit given for SEP so that, Final penalty - SEP credit = Final cash penalty
SEP cost to company: Actual cost to company of SEP implementation

NOTE: Due to differences in terminology and level of detail between regional SEP information, in some cases the figure listed as Final penalty may be the Final cash penalty after deduction for SEP credit

VIII. COMPLIANCE ACTIVITIES AND INITIATIVES

This section highlights the activities undertaken by this industry sector and public agencies to voluntarily improve the sector's environmental performance. These activities include those independently initiated by industrial trade associations. In this section, the notebook also contains a listing and description of national and regional trade associations.

VIII.A. Sector-related Environmental Programs and Activities

Common Sense Initiative

The EPA's Common Sense Initiative (CSI) was announced in November of 1993 to encourage pollution prevention in a few pilot industrial sectors including: iron and steel, electronics, metal plating and finishing, automobiles, printing, and oil refining. The program shifts regulatory focus from concentrating on individual toxic chemicals and media, to industry-wide approaches to environmental problems. A subcommittee will be formed for each industry and a strategic plan will be drawn up to identify opportunities to coordinate rulemaking, to streamline record-keeping and permitting requirements, and to identify innovative approaches in pollution prevention and environmental technology. For the iron and steel industry, a subcommittee has been formed and four workgroups have been established. The workgroups include representatives from industry, EPA (federal and regional), state environmental agencies, public interest groups, trade associations, and research institutions. The iron and steel CSI workgroups include: Innovative Technology, Permits Process, Compliance, and Brownfields. Projects proposed by each of the workgroups are subject to approval by the subcommittee. Project approval is expected in May, 1995. Common Sense Initiative contacts at EPA are:

Designated Federal Official (EPA Office of Water):
Mahesh Podar, 202-260-5387

Subcommittee Co-Chair (EPA Office of Water):
Bob Perciasepe, 202-260-5700

Subcommittee Co-Chair (EPA Region V):
Dave Ullrich, 312-886-3000

OECA contact (Compliance Workgroup):
Maria Malave, 202-564-7027

OECA contact (Permits Process Workgroup):
Mike Calhoun, 202-564-6031

VIII.B. EPA Voluntary Programs

33/50 Program

The "33/50 Program" is EPA's voluntary program to reduce toxic chemical releases and transfers of seventeen chemicals from manufacturing facilities. Participating companies pledge to reduce their toxic chemical releases and transfers by 33% as of 1992 and by 50% as of 1995 from the 1988 baseline year. Certificates of Appreciation have been given out to participants meeting their 1992 goals. The list of chemicals includes seventeen high-use chemicals reported in the Toxics Release Inventory. Exhibit 20 lists those companies participating in the 33/50 program that reported the SIC code 331 to TRI. Many of the companies shown listed multiple SIC codes and, therefore, are likely to carry out operations in addition to the iron and steel industry. The SIC codes reported by each company are listed in no particular order. In addition, the number of facilities within each company that are participating in the 33/50 program and that report SIC 331 to TRI is shown. Finally, each company’s total 1993 releases and transfers of 33/50 chemicals and the percent reduction in these chemicals since 1988 are presented.

Thirteen of the seventeen target chemicals are used in the iron and steel industry. Of all TRI chemicals released by the iron and steel industry, chromium and chromium compounds, a 33/50 target chemical, were released most frequently (from 347 facilities), and were the third greatest volume. Other target chemicals that were in the top ten TRI releases by volume and by number of facilities reporting that chemical released were nickel and nickel compounds, lead and lead compounds, and 1,1,1-trichloroethane. Approximately twelve percent of eligible iron and steel companies are currently participating in the program. Exhibit 20 shows that 49 companies comprised of 115 facilities reporting SIC 331 are participating in the 33/50 program. (Contact: Mike Burns 202-260-6394 or 33/50 Program 202-260-6907).

Exhibit 20: SIC 331 Facilities Participating in the EPA's 33/50 Program					
Parent Company	**City, State**	**SIC Codes Reported**	**Number of Participating Facilities**	**1993 Releases and Transfers (lbs)**	**% Reduction 1988 to 1993**
Acme Metals Inc.	Riverdale, IL	3312, 3499, 3479	3	157,232	38
Allegheny Ludlum Corporation	Pittsburgh, PA	3312	8	1,031,164	*
American Cast Iron Pipe Co.	Birmingham, AL	3322, 3317, 3325	1	315,184	25
Ameron Inc Delaware	Pasadena, CA	3272, 3317, 3443	1	184,882	**
Amsted Industries Incorporated	Chicago, IL	3315, 3496, 3471	1	1,834,493	66
Armco Inc.	Pittsburgh, PA	3312	11	1,849,709	4
Armco Steel Company L.P.	Middletown, OH	3312	2	159,944	*
Avesta Sheffield Holding Co.	New Castle, IN	3312	1	27,025	99
Bayou Steel Corporation	La Place, LA	3312	1	1,892	98
Bethlehem Steel Corporation	Bethlehem, PA	3312	9	792,550	50
Cargill Detroit Corporation	Clawson, MI	3312	8	717,558	31
Carpenter Technology Corp.	Reading, PA	3312	1	57,155	86
CF&L Steel Corp.	Pueblo, CO	3312	1	308,892	50
Commercial Metals Company	Dallas, TX	3312	3	36,457	47
Contran Corporation	Dallas, TX	3312, 3315	1	735,655	50
Cooper Industries Inc.	Houston, TX	3462, 3317	1	1,048,465	75
CSC Industries Inc.	Warren, OH	3312	1	8,808	50
Emerson Electric Co.	Saint Louis, MO	3469, 3315	1	2,140,497	50
First Mississippi Corporation	Jackson, MS	3312	1	200,977	***
Ford Motor Company	Dearborn, MI	3312	1	15,368,032	15
Geneva Steel	Orem, UT	3312, 3317, 3325	1	12,448	***
Inland Steel Industries Inc.	Chicago, IL	3312, 3274	1	733,786	48
J & L Specialty Steel Inc.	Pittsburgh, PA	3312	2	669,309	100
Kanthal Furnace Prods.	Bethel, CT	3315, 3316, 3357	1	21,581	41
Katy Industries Inc.	Englewood, CO	3316, 3351, 3353	1	82,256	52
Kerr-Mcgee Corporation	Oklahoma City, OK	2819, 3313	1	374,098	35
LTV Steel Co. Inc.	Cleveland, OH	3312	7	612,924	60
Lukens Inc.	Coatesville, PA	3312	4	312,442	14
Naco Inc.	Lisle, IL	3313	1	71,800	***
National Steel Corporation	Mishawaka, IN	3312	2	682,386	50
Olin Corporation	Stamford, CT	3351, 3316, 3356	1	574,673	70
Oregon Steel Mills Inc.	Portland, OR	3312, 3295	1	14,533	12
Plymouth Tube Company	Warrenville, IL	3499, 3317	1	76,694	*
Renco Group Inc.	New York, NY	3312	2	204,629	7
Republic Engineered Steels	Massillon, OH	3312	4	193,662	3

Exhibit 20: SIC 331 Facilities Participating in the EPA's 33/50 Program					
Parent Company	**City, State**	**SIC Codes Reported**	**Number of Participating Facilities**	**1993 Releases and Transfers (lbs)**	**% Reduction 1988 to 1993**
Roanoke Electric Steel Corp.	Roanoke, VA	3312	1	476	***
S K W Alloys Inc.	Niagara Falls, NY	3313	1	7,777	*
Slater Steels Corporation	Fort Wayne, IN	3312	1	22,205	50
Swva Inc.	Huntington, WV	3312	1	43,405	27
Talley Industries Inc.	Phoenix, AZ	3312	1	3,804	***
Texas Industries Inc.	Dallas, TX	3312	1	20,964	*
Thomas Steel Strip Corp.	Warren, OH	3471, 3316	1	6,839	50
Timken Co.	Canton, OH	3312	5	278,695	30
Toledo Coke Corporation	Toledo, OH	3312	1	18	90
USS Posco Industries	Pittsburg, CA	3312	1	182,431	56
USX Corporation	Pittsburgh, PA	3312	6	1,510,772	25
Walter Industries Inc.	Tampa, FL	3312	1	859,751	***
Weirton Steel Corporation	Weirton, WV	3312	1	183,497	**
Wheeling-Pittsburgh Corp.	Wheeling, WV	3312	6	560,055	66
Total			115		

* = not quantifiable against 1988 data.
** = use reduction goal only.
*** = no numerical goal.

Source: U.S. EPA, Toxics Release Inventory, 1993.

Environmental Leadership Program

The Environmental Leadership Program (ELP) is a national initiative piloted by EPA and state agencies in which facilities have volunteered to demonstrate innovative approaches to environmental management and compliance. EPA has selected 12 pilot projects at industrial facilities and federal installations which will demonstrate the principles of the ELP program. These principles include: environmental management systems, multimedia compliance assurance, third-party verification of compliance, public measures of accountability, community involvement, and mentor programs. In return for participating, pilot participants receive public recognition and are given a period of time to correct any violations discovered during these experimental projects. In the iron and steel industry, one company (California Steel of Fontana, California) submitted a proposal. (Contact: Tai-ming Chang, ELP Director, 202-564-5081 or Robert Fentress, 202-564-7023.)

Project XL

Project XL was initiated in March 1995 as a part of President Clinton's *Reinventing Environmental Regulation* initiative. The projects seek to achieve cost effective environmental benefits by allowing participants to replace or modify existing regulatory requirements on the condition that they produce greater environmental benefits. EPA and program participants will negotiate and sign a Final Project Agreement, detailing specific objectives that the regulated entity shall satisfy. In exchange, EPA will allow the participant a certain degree of regulatory flexibility and may seek changes in underlying regulations or statutes. Participants are encouraged to seek stakeholder support from local governments, businesses, and environmental groups. EPA hopes to implement fifty pilot projects in four categories, including facilities, sectors, communities, and government agencies regulated by EPA. Applications will be accepted on a rolling basis and projects will move to implementation within six months of their selection. For additional information regarding XL projects, including application procedures and criteria, see the May 23, 1995 Federal Register Notice, or contact Jon Kessler at EPA's Office of Policy Analysis (202) 260-4034.

Green Lights Program

EPA's Green Lights program was initiated in 1991 and has the goal of preventing pollution by encouraging U.S. institutions to use energy-efficient lighting technologies. The program has over 1,500 participants which include major corporations; small and medium sized businesses; federal, state and local governments; non-profit groups; schools; universities; and health care facilities. Each participant is required to survey their facilities and upgrade lighting wherever it is profitable. EPA provides technical assistance to the participants through a decision support software package, workshops and manuals, and a financing registry. EPA's Office of Air and Radiation is responsible for operating the Green Lights Program. (Contact: Susan Bullard at 202-233-9065 or the Green Light/Energy Star Hotline at 202-775-6650)

WasteWi$e Program

The WasteWi$e Program was started in 1994 by EPA's Office of Solid Waste and Emergency Response. The program is aimed at reducing municipal solid wastes by promoting waste minimization, recycling collection and the manufacturing and purchase of recycled products. As of 1994, the program had about 300 companies as members, including a number of major corporations. Members agree to identify and implement actions to reduce their solid wastes and must provide EPA with their waste reduction goals along with yearly progress reports. EPA in turn provides technical assistance to member companies and allows the use of the WasteWi$e logo for promotional purposes. (Contact: Lynda Wynn, 202-260-0700 or the WasteWi$e Hotline at 1-800-372-9473)

Climate Wise Recognition Program

The Climate Change Action Plan was initiated in response to the U.S. commitment to reduce greenhouse gas emissions in accordance with the Climate Change Convention of the 1990 Earth Summit. As part of the Climate Change Action Plan, the Climate Wise Recognition Program is a partnership initiative run jointly by EPA and the Department of Energy. The program is designed to reduce greenhouse gas emissions by encouraging reductions across all sectors of the economy, encouraging participation in the full range of Climate Change Action Plan initiatives, and fostering innovation. Participants in the program are required to identify and commit to actions that reduce greenhouse gas emissions. The program, in turn, gives organizations early recognition for their reduction commitments; provides technical assistance through consulting services, workshops, and guides; and provides access to the program's centralized information system. At EPA, the program is operated by the Air and Energy Policy Division within the Office of Policy Planning and Evaluation. (Contact: Pamela Herman, 202-260-4407)

NICE^3

The U.S. Department of Energy and EPA's Office of Pollution Prevention are jointly administering a grant program called The National Industrial Competitiveness through Energy, Environment, and Economics (NICE^3). By providing grants of up to 50 percent of the total project cost, the program encourages industry to reduce industrial waste at its source and become more energy-efficient and cost-competitive through waste minimization efforts. Grants are used by industry to design, test, demonstrate, and assess the feasibility of new processes and/or equipment with the potential to reduce pollution and increase energy efficiency. The program is open to all industries; however, priority is given to proposals from participants in the pulp and paper, chemicals, primary metals, and petroleum and coal products sectors. The program has worked with the iron and steel industry to evaluate the feasibility of an on-site hydrochloric acid recovery system for galvanizers and small- to medium-sized steel manufacturers. (Contact: Bill Ives at DOE's Golden Field Office, 303-275-4755)

VII.B. EPA Voluntary Programs

Strategies for Pulp & Paper and Steel Industries

The U.S. Department of Energy is examining the relationships between productivity, energy efficiency and environmental compliance in the pulp & paper and steel industries. Productivity and energy efficiency investments often complement each other, but can conflict with end-of-pipe emission control projects designed to reduce regulated pollutants. By sponsoring this project, the DOE seeks to better understand such conflicts and use this information to help identify ways DOE and other federal agencies can help industry meet mutual goals in these important areas. The project consists of two phases: 1) industry field consultations will be conducted to discuss and clarify the issues; and 2) quantitative analysis will evaluate the interplay between productivity, energy efficiency, and pollution abatement investments. (Contact: Jeff Dowd at 202-586-7258)

VIII.C. Trade Association/Industry Sponsored Activity

VIII.C.1. Industry Research Programs

Without technological changes, the requirements of the Clean Air Act affecting coke ovens may force the shutdown of many facilities. To avoid possible facility closings, the industry is actively investigating alternatives to the conventional coke-oven/blast furnace method of making iron. One promising technology, the direct steelmaking project which was jointly funded by the American Iron and Steel Institute (AISI) and the U.S. Department of Energy (DOE), concluded on March 31, 1994. This technology reduces, melts, and refines iron in a single reactor. An opt-in, DOE cost-sharing program for the smelting of steel plant waste oxides began on April 1, 1994. Based on the success of recent trials, and the further knowledge that was gained from this follow-on program, the technology is now well understood and fully developed. A feasibility study for a demonstration plan is being developed. Under a related project, the AISI and member companies are working with the U.S. Bureau of Mines on a jointly funded research project to improve the dewatering of a variety of steel plant sludges. Currently, the sludges contain too much moisture to permit economic recycling to recover metal values. (Contact: Dave Rice 801-584-4130).

Another cokeless ironmaking technology, called the Cipcor or Corex process, eliminates the need for a coke plant, has integral coal desulfurizing, is amenable to a variety of coal types, and produces a gas that can be used to fire a cogeneration plant. This project will begin in 1995; capital outlays are expected to reach $800 million. Under the DOE Clean Coal Technology Demonstration Program, the Corex construction project may receive a $150 million grant. For more information on the DOE project, contact J. Lee Bailey (216) 447-3235.

Instead of eliminating coke production, two research projects run by Bethlehem Steel are focused on reducing coke process emissions. The Sparrows Point facility on Chesapeake Bay was the proposed site for one project. At this facility, the Davy Still Autoprocess for pre-combustion cleaning of coke ovens was to be demonstrated. This process utilizes coke oven battery process water to strip ammonia and hydrogen sulfide from coke oven emissions. The facility was constructed but is not in operation due to a suspension of coke-making operations by Bethlehem Steel at that facility. Discussions are ongoing over re-establishment of coke production at Sparrows Point. The other Bethlehem Steel project is a demonstration plant of the British Steel blast furnace granulated coal injection process. In this process, granulated coal is used instead of oil and natural gas in the blast furnace. Unlike natural gas, granulated coal does not cause furnace temperature reductions when it is introduced and thus improves process efficiency. Pollutant outputs are reduced as coal sulphur is removed by flux and bound in the slag. The process replaces natural gas usage and reduces 40 percent of the coke requirement. The project facility, located in Burns Harbor, Indiana, is expected to be complete in January of 1995. The EPA project manager for the Bethlehem Steel projects is Jeff Summers (301) 903-4412.

Another project focussing on reduced emissions from cokemaking is a process under development by Calderon Energy. A small scale oven was constructed and operated in Alliance, Ohio and a full scale oven is under consideration for funding by the Department of Energy (DOE). For further DOE information, contact John Augustine (412) 892-4524.

VIII.C.2. Summary of Trade Associations

American Iron and Steel Institute	Members: 50 companies
1101 17th Street, NW	Staff: 44
Washington, DC 20036-4700	Budget:
Phone: (202) 452-7100	Contact: Bruce Steiner,
Fax: (202) 463-6573	VP-Environment and Energy

The American Iron and Steel Institute (AISI), founded in 1908, mainly represents integrated iron and steel manufacturers. Based on tonnage of production, AISI represents the companies responsible for 70 percent of U.S. steel manufacture. As the major trade group for the industry, AISI has a diverse agenda. The AISI conducts market development by working with major customer groups (e.g., automotive, machinery) to maintain and promote steel as the material of choice. The AISI is also involved in legislative and regulatory activities; AISI members rely on the organization to keep them abreast of legislative and regulatory developments. The AISI conducts research on manufacturing technology, basic materials, environmental quality control, energy, and fuel consumption. The AISI also compiles industry (including non-members) statistics through surveys. AISI publications are the *American Iron and Steel Institute-Annual Statistical Report*, as well as technical manuals and pamphlets on steel. The AISI holds several meetings and other workshops and seminars for member company representatives.

Specialty Steel Industry North America	Members: 21 companies
3050 K Street, NW	
Suite 400	
Washington, DC 20007	
Phone: 202-342-8630	
Fax: 202-338-5534	

The Specialty Steel Industry of North America (SSINA) is a national trade organization comprised of 21 producers of specialty steel products, including stainless, electric, tool, magnetic, and other alloys. SSINA represents over 90 percent of the North American specialty steel industry. The primary purpose of SSINA is to promote and encourage a better understanding between members of the North American specialty steel industry and federal and state officials, and to provide and encourage governmental action in support of the continued growth of a strong North American specialty steel industry. SSINA is comprised of a number of task forces and committees which pursue issues of interest to the North American specialty steel industry, including domestic and international trade, environmental, critical materials matters, manufacturing and standards issues, and other government-related matters. The SSINA committees meet quarterly, normally alternating between Washington, D.C. and Pittsburgh.

Steel Manufacturers Association (SMA)
1730 Rhode Island Avenue, NW
Suite 907
Washington, DC 20036-3101
Phone: 202-296-1515
Fax: 202-296-2506
email: steelnet@aol.com
World Wide Web home page: http://www.steelnet.org
Members: 55

The SMA is the primary trade association of electric arc furnace steelmakers. Last year, EAF steelmakers recycled 38.2 million metric tons of iron and steel scrap. Purchased scrap accounts for almost 100% of the feedstocks used in an EAF to make new steel. Other SMA companies are reconstituted integrated (ore-based) steelmakers, with management practices similar to those of the EAF companies. The SMA Environment Committee meets frequently to address issues affecting the steel industry and works with the EPA and other government agencies to implement effective environmental programs. The SMA also has technical and human resources committees which meet to exchange information and develop public policy positions, as well as ad-hoc task forces to handle specific matters such as radioactive scrap detection, development of emission monitoring protocols, and the EPA's Common Sense Initiative. With 44 U.S., 8 Canadian, and 3 Mexican member companies geographically dispersed across the continent, the SMA is the largest steel trade association in North America in terms of membership. In 1994, the SMA membership accounted for approximately 40% of all steel shipments in the U.S., and as a growing segment of the industry, the SMA share of total U.S. steel production is expected to account for 50% within one decade.

International Iron and Steel Institute
Institut International du Fer et de l'Acier
120, rue Colonel Bourg, B-1140
Brussels, Belgium 32 2 726 50 95
Members: 165
Staff: 20
Budget:
Contact: Ian Christmas, Deputy Secretary General

The International Iron and Steel Institute (IISI) is comprised of steel-producing companies, affiliated federations, and technical societies in 48 countries. The IISI seeks to contribute to the steel industry worldwide. Major functions are: to provide a forum for free and open discussions of the industry's problems and opportunities; to undertake research in scientific, technological, economic, financial, governmental, sociological, legal, environmental, and other aspects of the industry; to collect, evaluate, and disseminate statistics and information concerning matters affecting the steel industry; to establish and maintain liaisons with other organizations related to steel; to promote the use of steel. Some IISI committees include Economic Studies, Environmental Affairs, and Industrial Relations. The IISI publishes the monthly *Iron and Crude Steel Production* (in English) and the annuals *Steel Statistical Yearbook* (in English) and *World Steel in Figures* (in English). IISI also publishes conference proceedings and reports on the following issues: environment, economics, raw materials, technology, market promotion, and public relations. The IISI holds an annual world conference.

Association of Iron and Steel Engineers
3 Gateway Center, Suite 2350
Pittsburgh, PA 15222
Phone: (412) 281-6323
Fax: (412) 281-4657

Members: 10,000
Staff: 19
Budget: $2,500,000

The Association of Iron and Steel Engineers (AISE) consists of engineers, operators, and suppliers in the steel industry. Founded in 1907, this association works to improve the technical phases of the production and processing of iron and steel via technical reports and industry awards. Divisions include Environmental Engineering, Steel Producing, and Continuous Casting. AISE publications include a monthly, *Iron and Steel Engineer* and a *Directory of Iron and Steel Plants*. Conferences are semi-annual.

Additional Related Associations

ASM International
9639 Kinsman Rd.
Materials Park, OH 44073-0002
Phone: (216) 338-5151

Society for Mining, Metallurgy, and Exploration, Inc. (SME, Inc.)
P.O. Box 625002
Littleton, CO 80162-5002
Phone: (303) 973-9550

The Mining Metals and Materials Society (TMS)
420 Commonwealth Drive
Warrendale, PA 15086
(412) 776-9000

IX. CONTACTS/ACKNOWLEDGMENTS/RESOURCE MATERIALS

For further information on selected topics within the iron and steel industry a list of contacts and publications are provided below.

Contacts[e]

Name	Organization	Telephone	Subject
Maria Malave	EPA/OECA (Office of Enforcement and Compliance Assurance)	202-564-7027	Regulatory requirements and compliance assistance
Steve Sisk	NEIC (National Enforcement Investigations Center)	303-236-3636 ext. 540	Regulatory requirements and industrial processes
James Maysilles	EPA/OAR (Office of Air and Radiation)	919-541-3265	Regulatory requirements (air)
Bernard Caton	EPA/OW (Office of Water)	202-260-7849	Regulatory requirements (water)
Gobind Jagtiani Jeff Dowd	DOE (Department of Energy)	202-586-1826 202-586-7258	Energy efficiency and environmental compliance
Bruce Steiner	AISI (American Iron and Steel Institute)	202-452-7100	Environment and energy
Javier Garcia	EPA/Region IV	404-347-3555	Inspections, regulatory requirements (RCRA)
Ed Wojciechowski	EPA/Region V	312-886-6785	Inspections, regulatory requirements (air)
Gerald Houck	U.S. Bureau of Mines	202-501-9439	Industrial processes
	U.S. Bureau of Mines: Center for Health and Safety	412-892-6602	Health and safety issues

[e] Many of the contacts listed above have provided valuable information and comments during the development of this document. EPA appreciates this support and acknowledges that the individuals listed do not necessarily endorse all statements made within this notebook.

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Endnotes

1. Variation in facility counts occur across data sources due to many factors including, reporting and definitional differences. This notebook does not attempt to reconcile these differences, but rather reports the data as they are maintained by each source. Only preliminary data is available from the *1992 Census of Manufactures.* The final version which includes all data will not be available until mid-1995. *Census of Manufactures*, U.S. Department of Commerce, Bureau of the Census, Preliminary Report Industry Series, MC92-I-33A(P) (Industries 3312, 3313, 3315, 3316, and 3317), 1994.

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